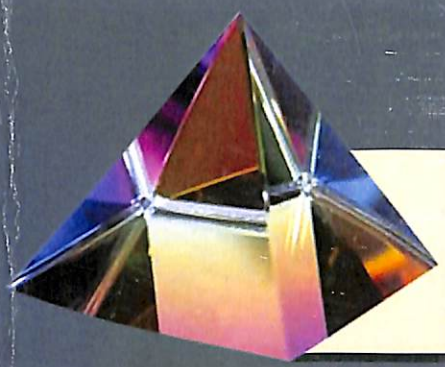

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Studying the impact of Teaching Learning Material on Social and Motor Development and Academic Achievement of children studying in Urban and Rural primary government school.

Swikriti Sensharma and Punam Mehra

ABSTRACT

The present study was undertaken with the aim to find out the impact of teaching learning material on the children those who are exposed to Teaching Learning Material and the children those who are not exposed to Teaching Learning Material in Rural and Urban areas. The study was taken in the district of Howrah, West Bengal. The study was designed with 400 children studying in government primary school of both urban and rural areas [viz. boys (N =200) and girls (N =200)] of early childhood [age group = 6 to 12 years]. The subjects were considered on the basis of simple random sampling which consists of 50 children from each school. The data pertinent to the study were collected with the help of a self prepared questionnaire on social development, motor development and academic achievement. Two standardized tests were also applied to assess the motor development with the use of two apparatus – finger dexterity board and steadiness tester. The obtained results reflected that, in the areas of social development, motor development and in the academic achievement there is a significant difference between the children those who are exposed to teaching learning materials and those who are not exposed to teaching learning materials in both the urban and rural areas. The children using teaching learning materials have performed far better in all the assessments than the children those who are not exposed to teaching learning materials.

Keywords - Teaching Hearing Material, Social Development, Motor Development, Academic Achievement, Primary Government School

Introduction

Education is an essential human virtue. Man becomes man through education. He is what education makes him. Thus, education is the most important aspect of a human being which is philosophical as well as sociological concept denoting ideologies, curricula and pedagogical techniques of the inculcation and management of knowledge and the social reproduction of personalities and cultures[1].

As we all know that today's age is the age of science and technology. The teaching learning programmes have also been affected by it. The process of teaching - learning depends upon the different type of equipment available in the classroom[5].

Every individual has the tendency to forget. Proper use of teaching aids helps to retain more concepts permanently. With the help of the teaching aids Students can learn better when and they are motivated properly through different teaching aids. Teaching aids develop the proper image when the students see, hear, taste and smell properly. Teaching aids provide complete example for conceptual and intellectual thinking. The teaching aids create the environment of interest for the students and hence children get motivated to create something new. Teaching aids helps to increase the vocabulary of the students. Teaching aids not only helps the students but also helps the teacher to get some time and make learning permanent. Teaching aids provide direct experience to the students[3].

Therefore it is very much essential for the school to incorporate teaching learning material in the school curriculum for the benefit of the students. Teaching aids motivate the students so that they can learn better. Through teaching aids, the teacher clarifies the subject matter more easily. It facilitates the proper understanding to the students which discourage the act of cramming. Teaching aids helps to increase the vocabulary of the students more effectively. Teaching aids can be made of any leftover items or any concrete material and thus saves the cost and can be used effectively. Ones made item can be kept for long in use and thus can be used again and again in a classroom to make the matter understanding with the use of the teaching aid. Teaching aids make the classroom live as every children love to play with colors, paper and many other materials and equally participate in creating something new and innovative and thus not only the students but also the teachers become active participants. The study matter direct from books becomes very monotonous and thus the children start losing interest in studying. The use of teaching aids avoids dullness and encourages children for better understanding and study material interesting. Teaching aids provide direct experience to the students.

With the help of teaching and learning material children use their motor ability and develops their gross motor skills and fine motor skills. While making the materials children get to use their ideas

and make innovative projects. With the help of this mostly their fine motor skills develop like they become capable of executing complex detail-oriented craft projects involving beading, sewing, scrap booking, building models also good at using simple tools with adult supervision.

Children artistic ability can truly begin to shine during this stage as improved fine-motor skills and imagination combine[5].

Children at this stage work together and develop their social skills. With the help of teaching and learning materials children usually sit and work together and share their views and ideas with each other. This helps in developing their social skills and learns to co-operate and wait for their turn while working. At this stage they are becoming social beings and often prefer the company of their peers and also express their preference for playing with them. Playing and getting along is an important aspect of social development.[5]

A very important enhancer of academic achievement is the presence of physical activity. Exercise specifically increases executive brain functions such as attention span and working memory. Education, according to Coombs (1970) consists of two components. He classified these two components into inputs and outputs. According to him, inputs consist of human and material resources and outputs are the goals and outcomes of the educational process. Both the inputs and outputs form a dynamic organic whole and if one wants to investigate and assess the educational system in order to improve its performance, effects of one component on the other must be examined. Teaching Aids which are educational inputs are of vital importance to the teaching of any subject in the school curriculum. Materials which are related to the basic contents of a course or a lesson, helps in-depth understanding of such a lesson by the students in that they make the lesson attractive to them, thereby arresting their attention and thus, motivating them to learn.

So, the overall aim for this study is to find out the impact of teaching learning materials used by the primary schools in developing their social and motor skills resulting in overall academic achievement of the children.

A study[8] was conducted where the purpose of the study was to investigate the influence of the use of teaching learning materials on children performance in pre-schools. The following were the main objectives of the study: to establish the teaching and learning materials used in pre-schools, to find out the effects of teaching and learning materials on children performance in pre-schools, to determine the attitude of the teachers towards the use of teaching and learning materials in pre-school. The study adopted a descriptive survey design to establish the influence of teaching and learning materials. The study targeted a sample of 97 teachers and 52 head teachers. Findings from the study materials indicated that the majority of teachers use visual materials such as charts and pictures. The pre-school teacher revealed that pre-school learners seem to enjoy learning when teaching and learning materials are used resulting in achievement.

Another study focused on the Teaching Aids which has been a common feature in mathematics classrooms although in some instances they were not appropriately used[9]. This study was undertaken to explore whether teaching aids have any impact on teaching and learning mathematics, especially in the Foundation Phase classes. It was conducted in two primary schools in QwaQwa, in the Free State Province in South Africa. It was guided by the constructivist approach, which views mathematics learning as the development of ideas, processes and understanding in a social setting rather that the mere passing on of knowledge from teacher to pupil. Teaching aids, as educational materials, create opportunities which may reveal misconceptions on the part of both teachers and learners. Some teaching aids are quite simple to use and others require training to be able to extract mathematics from them. The study demonstrated that without strictly classifying them in any preferential groupings, teachers provide varying justifications for using teaching aids in their classrooms. In most cases they incorporate in their mathematics lessons any concrete material that will help pupils to relate mathematics to the real world and provide pupils with hands-on activities that will de-emphasize routine and memorizing facts, algorithms, formulas and theorems. Most importantly the study revealed that teaching aids have a positive effect on teaching mathematics even in less than optimal circumstances, that is, under-resourced, rural, second language classrooms.

It was found from the different research papers and studies that the teaching learning materials are not only helpful or beneficial for the children but is also helping other people as well like in one of the study was done with the importance of learning resources among the post graduate students[12]. This study aims to investigate the perceptions of Libyan accounting graduates regarding the teaching methods that Libyan accounting educators prac-

ticed in their classrooms, the adequacy of teaching and learning resources at Libyan universities, and to test whether or not there is any relationship between adequacy of teaching and learning resources at Libyan universities and the teaching methods used by Libyan accounting educators. Quantitative data was collected from fifty four Libyan post-graduate students. Findings revealed that accounting graduates reported a high level application of teacher-centered methods than learner-centered methods at Libyan universities. Furthermore, accounting graduates in this study indicated the inadequacy of vital teaching resources. While, no one of the teaching resources indicated a significant relationship with the teacher-centered teaching methods, the learner-centered teaching methods showed positive and significant relationship with most of these teaching resources. As these teaching methods need some special resources such as laptops, internet, computers, and so on, indeed, lack of these resources will hinder the use of such teaching methods.

Methodology

The present study was conducted to examine the effect of Teaching Learning Material on the social, motor and academic achievement of children and compare it that with the children who are not exposed to Teaching Learning Materials. The variables were set after conducting a detailed study of researchers already conducted in similar areas. The objective of this study is to assess the effect of teaching learning material on the social, motor and academic achievement of the rural and urban primary government school children.

The Data Collection Method:

The questionnaire was prepared in keeping the objective of the study and also the age of the sample. As the sample taken for the research is from the government schools of west Bengal and their medium is Bengali therefore the questions given are very easy to understand and are direct. The major part of the questions is given in English as they have incorporated English subject in their curriculum and they all have basic knowledge on English.

According to the two age groups the questionnaire was divided into two on the basis of social and motor development and academic achievement of the children and also on the basis of need for the particular age. The questions asked are close – ended question, in which the respondents are given with a answer choices of Yes or No which was calculated on the basis of 1:0 ratio.

Table:1 Showing The Characteristics Of Sample:

Group	Sample Size	Age Group		Class		No. of Respon-dents	No. of Respon-dents	Commu-nity	Average Monthly Income of their parents
		A	B			Boys	Girls		
I	200	6-8	9-12	II-III	IV-V	100	100	Bengali	10,000 - 2,500/-
II	200	6-8	9-12	II-III	IV-V	100	100	Bengali	8,000 - 2,000/-

Group I - Children those who are exposed to teaching and learning material in urban and rural areas.

Group II - Children those who are not exposed to teaching and learning material in urban and rural areas.

Age Group A - Children of age group 6 – 8 years.

Age Group B - Children of age group 9 – 12 years.

The Method of Data Processing and Analysis:

The data collected through the printed questionnaire were subjected to rigorous analysis in order to derive the conclusion regarding the usefulness of teaching learning material. Further testing of hypotheses (by applying fishers t- test) has been used here to check whether there exists any significant difference between the social and motor development as well as academic achievement of children using teaching learning materials and the children those who are not using teaching learning materials in both the urban and rural areas. The data was collected through distribution of questionnaires to the children of both the age groups (age 6 to 8 years and 9 to 11 years). The respondents were asked to fill the questionnaires independently.

The test has been applied in the following way:

As regards to the description of the questionnaire, special care was taken to frame the questions to make them simple and easily understandable to the respondents. Most of the questions were objective type with simple options like 'Yes – No'. The initial questions were general meant to make a rapport with the respondent so that they would feel relaxed to answer the succeeding questions. However, some of the questions which were meant to derive certain special information were constructed on the basis of their use of teaching learning materials.

The questions were bi-response type with the responses being 'Yes' or 'No'. The score attached with 'Yes' is one and that with 'No' is zero. The questions are so framed that "Yes" indicates presence of a skill whereas "No" indicates absence/ lack of that skill. Hence, a high score will thereby

imply a good skill and a low score will imply a poor skill on the part of the development of the children. An aggregation of this score has been done separately for children those are exposed to teaching learning material and to the children who are not exposed to teaching learning material in both urban and rural areas.

For the assessing the children's social development the questionnaire was divided into three major parts to see whether the children are socially active or not which consisted of children's reaction towards self-help skills, individual activity and acceptance according to which children are rated in their social development. The corresponding mean scores are then found.

For assessing the children's motor development again the questionnaire was divided under the two major parts of motor development – Gross motor skills and Fine motor skills, according to which children are rated in their motor development. Further two standardized tests were applied on the children to see their fine motor skills by applying Finger Dexterity Test and The Steadiness Tester. The corresponding mean scores are then found. I have also incorporated some activities within the questionnaire which was a part of it i.e; I have asked the children to make small puppets with the help of the plasticin provided to them and has also given a small cloth in which they had to do buttoning and tie a shoe lace to see whether they are able to do or not.

For assessing the children's academic achievement a questionnaire was prepared on the basis of two main subject's i.e; English and Maths according to which children are rated in their academic achievement. Further to be precise to see the academic achievement children's progress cards were observed and teacher's opinion was also taken. The corresponding mean scores are then found.

Since, our objective has been to examine whether their lies any significant difference in the social and motor development as well as academic achievement of the children those are exposed to teaching learning materials and not exposed to teaching learning materials in both rural and urban areas.

Hence, the corresponding Null Hypothesis (H_o) states that there exists no significant difference in the children those are exposed to teaching learning material and to the children who are not exposed to teaching learning material in both urban and rural areas.

The Alternative Hypothesis (H_1) states that there exists significant difference in the children those are exposed to teaching learning material and to the children who are not exposed to teaching learning material in both urban and rural areas

The testing's has been done separately in order to find the impact on the average social development, motor development and academic achievement of the children those who are exposed to teaching learning materials and the children those who are not exposed to teaching learning materials in both the urban and rural areas.

Hence, $H_o: \mu_1 = \mu_2$ and $H_1: \mu_1 \neq \mu_2$

Where, μ_1 = Population mean score of the children those are exposed to teaching learning material and in both urban and rural areas

μ_2 = Population mean score of the children who are not exposed to teaching learning material in both urban and rural areas.

Test statistic for fisher's test. Since, the samples are independent,

Hence,

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S\sqrt{1/n_1 + 1/n_2}}$$

Here $\bar{x}_1$= Sample mean score of respondents with teaching aids.

$\bar{x}_2$= Sample mean score of respondents without siblings.

n_1 = number of children with teaching aids.

n_2 = number of children without teaching aids.

S = Standard Deviation of $(\bar{x}_1 - \bar{x}_2)$.

This computed value of t will be compared to the tabulated t value at 5% level of significance to detect that whether there exists any significant difference in the children those are exposed to teaching learning material and to the children who are not exposed to teaching learning material in both urban and rural areas. If the computed t value is equal to or higher than the tabulated value then the Null Hypothesis will be rejected; else it will be accepted.

Results

The major objective of the present study was to assess the impact of teaching learning material on the children studying in urban and rural primary government schools those who are exposed to teaching learning materials and those who are not exposed to teaching learning materials. As mentioned earlier, 400 children, were taken as subjects who were asked to fill up the questionnaire as well as two tests were applied for this research study. The collection data revealed a marked difference in the areas of study conducted between the children those who are exposed to

teaching learning materials and those who are not exposed to teaching learning materials in both urban and rural areas. Their personal information was taken and all questionnaire and the results of tests were analyzed and compiled. The findings and the results of the study are presented in this chapter.

Data on the social development, motor development and academic achievement for the age group 6-8 years and 9-12 years has been clearly given for the children dwelling in both rural and urban areas in the following tables with their mean average, standard deviation and their't' values of the children those who are exposed to teaching learning material and the children those who are not exposed to teaching and learning materials. Further discussions are made on the basis of the results obtained.

Following are some of the charts showing the

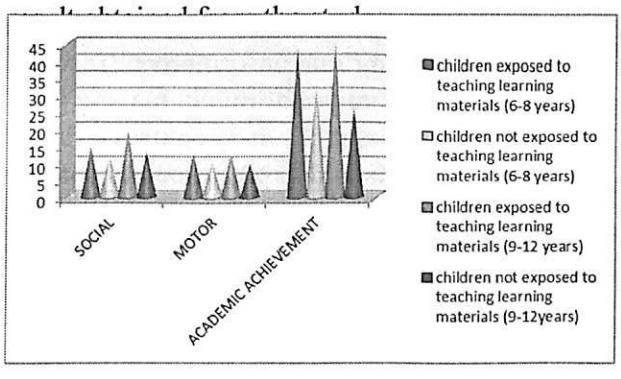

Fig 1: Showing the mean average of the children in the areas of social development, motor development, and academic achievement of children exposed and not exposed to teaching

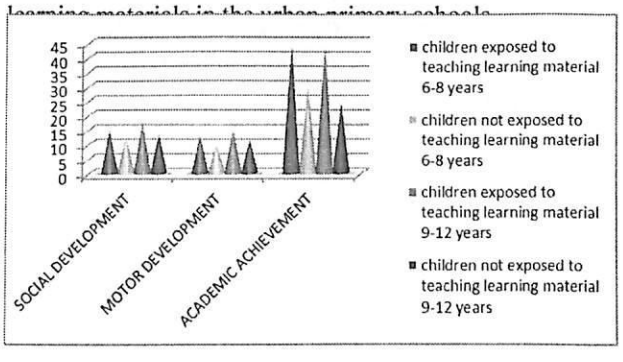

Fig 2: showing the mean average of the children in the areas of social development, motor development and academic achievement of children exposed and not exposed to teaching learning materials in the rural primary schools.

From the above two charts the mean average found in urban and rural areas is higher among the children those who are exposed to teaching learning materials compared to those who are not exposed to teaching learning materials.

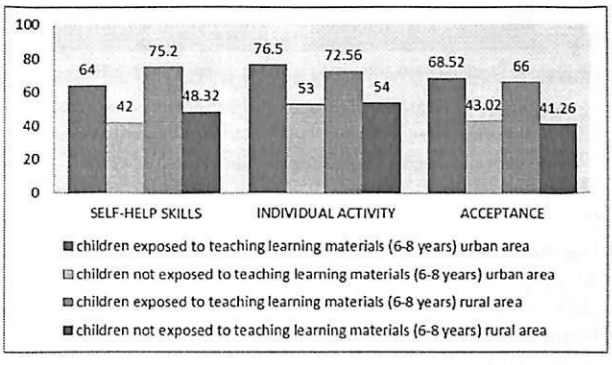

Fig 3: Showing the percentage in the areas of social development including – self-help skills, individual activity and acceptance of the children exposed and not exposed to teaching learning materials of 6-8 age group.

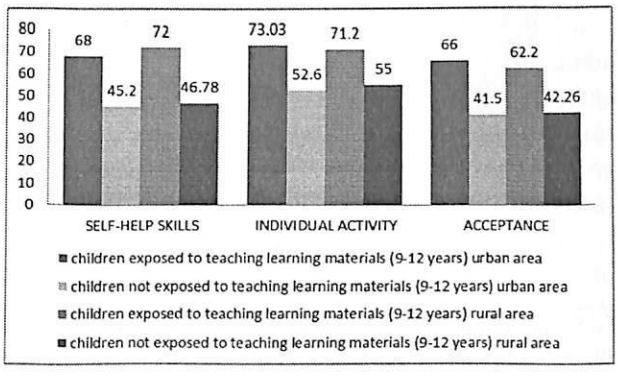

Fig 4: Showing the percentage in the areas of social development including – self-help skills, individual activity and acceptance of the children exposed and not exposed to teaching learning materials of 9-12 age group.

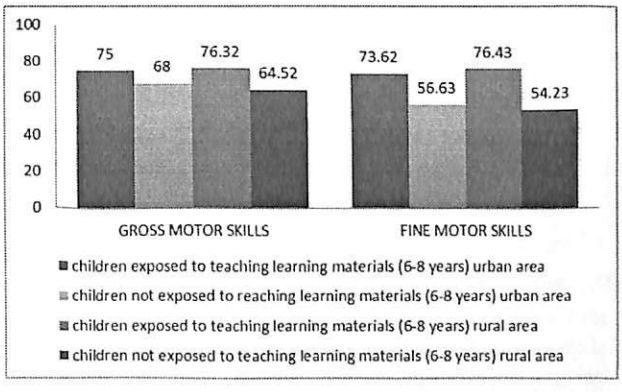

Fig 5: Showing the percentage in the areas of motor development including – gross motor skills and fine motor skills of the children exposed and not exposed to teaching learning materials of 6-8 age group.

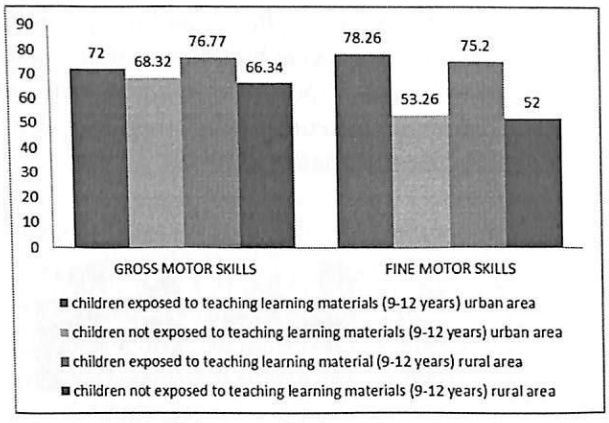

Fig 6: Showing the percentage in the areas of motor development including –gross motor skills and fine motor skills of the children exposed and not exposed to teaching learning materials of 9-12 age group.

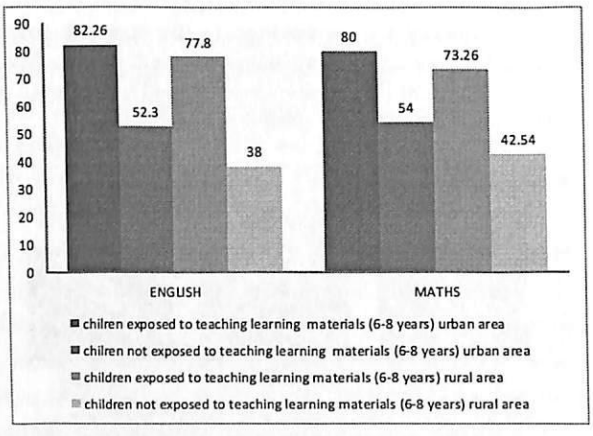

Fig 7: Showing the percentage in the areas of academic achievement including – performance in English and Maths of the children exposed and not exposed to teaching learning materials of 6-8 age group.

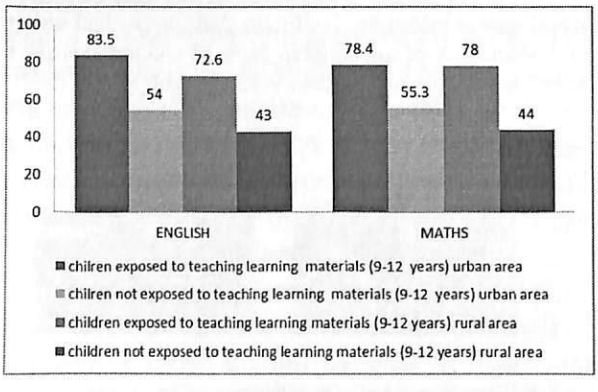

Fig 8: Showing the percentage in the areas of academic achievement including –performance in the English and Maths of the children exposed and not exposed to teaching learning materials of 9-12 age group.

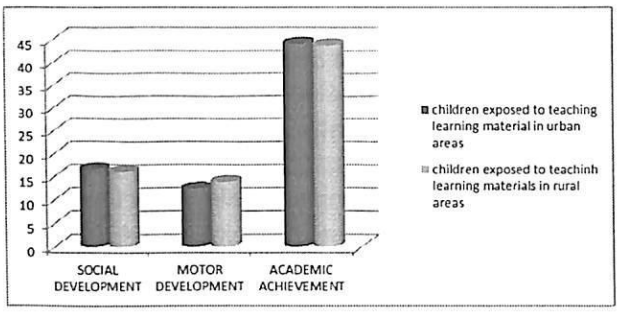

Fig 9: Showing the mean average of the children in the areas of social development, motor development, and academic achievement of children exposed to teaching learning materials of both 6-8 and 9-12 age groups in the urban and rural primary schools.

Discussion

Teaching learning materials have become an integral part in the teaching learning process as it enhances the quality of teaching and better understanding of the subject matter. It gives a practical knowledge to the students as well as makes the learning interesting and informative. Teaching materials play an important role in making learning-teaching process in the daily courses efficient, by presenting signs and explanations to students and making students comprehend these signs and explanations. Teaching materials provide a great deal of convenience in teacher's ability to convey a message to students in an accurate, proper, clear and understandable manner; in making abstract knowledge concrete and in enabling students to comprehend complex ideas through simplification. When properly used, printed materials, audiovisual materials and experience-giving methods, help make the learning process easy and enduring.

Teachers should guide them and encourage them while making teaching learning materials. Evaluations (tests, etc.) can be used to assign grades, check learning, give feedback to students, and improve instruction by giving feedback to the teacher. Though students should be the center of instruction, in many cases, teachers and students rely on materials, and the materials become the center of instruction.

The present study focused on three variables, viz. social development, motor development and academic achievement. The children's performance was assessed through a self prepared questionnaire while motor was further assessed with the help of two standardized tests.

According to the result obtained from the present study there is a significant difference (Table 5.1 and 5.3 $t_{0.05}$= 3.12 and 16.5) in the area of social development of children of age group 6-8 and 9-12 studying in urban schools who are exposed to

Teaching Learning Material and who are not, therefore H_o1 is rejected.

Similar observation has been found from the present study in the area of social development conducted in the rural area that there is a significant difference (Table 5.2 and 5.4 $t_{0.05}$= 6.6 and 6.25) in the area of social development of children of age group 6-8 and 9-12 studying in rural primary government schools who are exposed to Teaching Learning Material and who are not, therefore H_o2 is rejected.

The scores obtained from the present study in the area of motor development of the children, it is found that there is a significant difference (Table 5.1 and 5.3 $t_{0.05}$= 9.33 and 10.3) in the area of motor development among the children those who are exposed to teaching learning material and those who are not exposed to teaching learning material. Hence, the H_O3 has been rejected.

Further the scores obtained from the present study in the area of motor development of the children, it is found that there is a significant difference (Table 5.2 and 5.4 $t_{0.05}$= 9.51 and 17) in the area of motor development among the children those who are exposed to teaching learning material and those who are not exposed to teaching learning material. Hence, the H_O4 has been rejected.

The scores obtained from the present study in the area of academic achievement of the children, it is found that there is a significant difference (Table 5.1 and 5.3 $t_{0.05}$= 12.12 and 26.5) in the area of academic achievement among the children those who are exposed to teaching learning material and those who are not exposed to teaching learning material. Hence, the H_O5 has been rejected.

Further scores obtained from the present study in the area of academic achievement of the children, it is found that there is a significant difference (Table 5.2 and 5. 4 $t_{0.05}$= 26.2 and 26.4) in the area of academic achievement among the children those who are exposed to teaching learning material and those who are not exposed to teaching learning material. Hence, the H_O6 has been rejected.

Further scores obtained from the present study in the area of social development among the children those are exposed to teaching learning materials in both urban and rural areas, in which I have combined both the age groups and taken it as one age group as (6-12), it is found that there is no significant difference (Table 5.5 $t_{0.05}$= 1.43) in the area of social development among the children those who are exposed to teaching learning material in both urban and rural areas. Hence, the H_O7 has been accepted.

From the present study in the area of motor development among the children those are exposed to teaching learning materials in both urban and rural areas, in which I have combined both the age groups and taken it as one age group as (6-12), it is found that there is a significant difference (Table 5.5 $t_{0.05}$= 16.3) in the area of motor development among the children those who are exposed to teaching learning material in both urban and rural areas. Hence, the H_O8 has been rejected.

Further scores obtained from the present study in the area of academic achievement among the children those are exposed to teaching learning materials in both urban and rural areas, in which I have combined both the age groups and taken it as one age group as (6-12), it is found that there is no significant difference (Table 5.5 $t_{0.05}$= 1.09) in the area of academic achievement among the children those who are exposed to teaching learning material in both urban and rural areas. Hence, the H_O9 has been accepted.

Therefore, from the above hypotheses it can be assumed that most of them are rejected which mean that there is a significant difference among the children those who are exposed to teaching learning materials and those who are not exposed to teaching and learning materials. Hence, it signifies that the teaching learning materials are helping children in their all round development and adding much more than books by increasing their attention span and making the curriculum interesting.

Conclusion

From the present study the students mean average in the area of social development is found to be greater among the children those who are exposed to teaching learning material than the children those who are not exposed. There has been a significant difference found in the area of social development and hence the null hypothesis proposed was rejected. Therefore further it can be said that the children those who are using teaching aids found to have develop better social skills and hence can easily interact and communicate with others.

According to the present study the students average in the area of motor development is found to be greater among the children those who are exposed to teaching learning material than the children those who are not exposed to teaching learning materials. There has been a significant difference found in the area of motor development and hence the null hypothesis proposed was rejected. Therefore further it can be said that the children those who are using teaching aids found

to have develop better motor skills and hence the children apparently reflects maturation of the brain as well as the muscles.

Again from the present study the students mean average in the area of academic achievement is found to be greater among the children those who are exposed to teaching learning material than the children those who are not exposed. There has been a significant difference found in the area of academic achievement and hence the null hypothesis proposed was rejected. Therefore further it can be said that the children those who are using teaching aids helps in-depth understanding of a lesson by the students in that they make the lesson attractive to them, thereby arresting their attention and thus, motivating them to learn. Learning materials are important because they can significantly increase student achievement by supporting student learning.

Hence, it can be further concluded that these results gives a clear understanding that every school should incorporate teaching learning materials in their curriculum as it will help children in there all round development and in better understanding of the study material. The teachers should use new teaching materials as well as let children develop materials themselves and teachers should always encourage children to develop new ideas and hence thereby helping children through all the developmental processes that takes place during this stage.

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Space Planning Considerations in School Design

Nazneen Zaman and Roshmi Banerjee

ABSTRACT

The purpose of the research is to find out the Space Planning Considerations for efficient School Design and design a model school accordingly. 10 schools in and around Kolkata was surveyed along with the help of questionnaires to find out the present facilities and features. The schools were rated by the designer on the space planning and other associated issues that influence the design process. The school having the best features serves as an inspiration to the designer. In a site, slightly away from the heart of the city, the designer has lent her vision in carving out a model school that has the ideal space planning features that contributes in creating a healthy environment that is conducive to learning. The proposed model school contains features necessary for providing a comfortable and holistic learning environment.

Keywords - Planning Principles, Service Consideration

Introduction

In space planning, the design professional carves out interior spatial areas, defines circulation patterns, and develops plans and layouts for furniture and equipment placement. Space planning services consider numerous design parameters, including the client's project goals and priorities, the client's organizational structure and relationships, space allocation criteria, building codes, access for the disabled, furniture standards, circulation and work flow, design considerations, the constraints of fixed building elements and building system interfaces, security and privacy issues, and flexibility for accommodating future space needs[4].

Importance of School Design

One area of thought in educational leadership and planning often overlooked is that the physical design and organization of the learning environment can have a profound impact on the success of the students and faculty of a school.

It is very essential to remember that school building is more than just a "box with a few openings and some basic furniture". Since, schools are the places which contribute greatly to the education, development and socialization of any country's youth.

Schools constitute the single most important learning environment - next to a child's home – for the formation and shaping of a child's personality and character. Where children spend most of their waking time, where children live, play – and learn. Hence we need to ensure that only qualified professionals are entrusted with these tasks.

Undoubtedly, the shortfall of infrastructure (i.e. classrooms) is one of the most serious problems in the educational sector of many developing countries. Available schools are often characterized by overcrowded classrooms and/or double-shift education, both of which arguably have a serious negative effect on the academic achievement of learners.

In other, more remote areas, children go without schooling - or attend schools in very makeshift classrooms: in caves, under trees or in converted rooms - such as store-rooms, garages, residential buildings, etc, which are usually wholly unsuitable for learning purposes[1].

Lack of proper planning and optimal use of available facilities often make the schools a very unpleasant experience.

Aims and Objectives

The aim of the researcher lies in finding out the planning considerations necessary for efficient school design.

The steps include:-

1 Surveying schools in Kolkata and around to find out the present facilities and features being offered

2 Identifying the considerations and necessary facilities of a model school that properly incorporated the different relationships between spaces of various activity areas.

3 To create a model school to provide an environment facilitating efficient space planning and relation between them.

Methodology

The chief objectives of the researcher lies in

1 Identifying from the case studies the criteria that goes towards making a model school in a site located slightly away from the heart of the city.
2 The selected criteria serve as an inspiration for the school proposed by the designer
3 10 schools were selected in the heart of Kolkata and a study was conducted to observe their spatial characteristics/designing features and attributes that contributed to their academic excellence.

Methods of data collection

1 The research data was collected via case study method. The subsequent data was assembled to design a Model School that satisfies the requisite criteria.
2 For this a questionnaire was formed and handed to the concerned representative of the school so as to get data about present facilities of the school The questionnaire aimed to identify the features that contributed to the space planning aspects of each school and its provisions for the students .Accordingly the facilities were rated and the school comprising of all the desired criteria was given the best rating.
3 Another observation data was formulated by the researcher herself to study the details of model classroom/laboratories/toilets.

The study investigated from several perspectives the school facilities, design process employed to design the new school.

Procedure for data collection

1 A standard questionnaire was formulated with all the evaluation criteria for a model school design and was handed over to the 10 schools
2 The collected data was assimilated in a tabular manner and a comparative analysis was made between all the schools to observe & relate the relevant features.
3 A rating process was followed to identify the school with the best criteria
4 Eventually the school with the best rating has been identified as the Model school. Its features serve as the guide for the proposed school by the designer.
5 Also an individual analysis was also done by the observer/researcher to study the design and dimensional criteria of the classrooms and toilets.

Tools used in the survey

1 A 3 meter stiff measuring tape used to measure the dimensions.
2 Camera
3 Questionnaire
4 Rating scale formulated by the researcher herself on a detailed analysis & study of all the respective schools.

Method of rating the schools

1 The schools were rated on the basis so as to find out which school had the best facilities
2 The questionnaire has different criteria and the schools have been rated from 1 to 10 on each criterion. The scale of rating starts from 1 to 10. The rate of 1 has been taken as the highest and the rate 10 has been given the lowest on the rating scale.
3 The different schools were given individual rating on each criteria and the total were done .The school having the lowest total was taken as Ideal school
4 The Characteristics of the Ideal School were imbibed by the designer in her proposed design.

Results and Discussion

The schools were rated and three school having the best features were taken into consideration.

Shri Shikshayatan School is rated as first, St Thomas Girls School as second and La Martinere for girls as third.

Characteristics of the Model School that can be incorporated by the Designer are as below:

Capacity of the School is 4064

Open Space

1 The Open Space around the building is adequate. There is enough area for circulation, and all the site elements & spaces related to each other. (As per the National Building Code of India there needs to be 6m wide space all around the Educational Institute. Also the open space must be 15% of the area of the layout[2].)
2 There is enough area for circulation.
3 The class has thermal comfort by windows only, not air conditioners.
4 There is a provision for lighting by both natural and artificial means.

(As per the National Building Code of India openings shall be $1/6^{th}$ of floor area for hot/wet climate[3].)

5 There is a separate assembly hall.
6 There is an auditorium or an audio visual room.

7 There is provision for Outdoor Play / Music / Dance / Swimming Pool.

(As per National Building Code of India Minimum average dimension of recreational space shall not be less than 7.5 m . If the average width of such recreational space is less than 24m, the length shall not exceed 2.5 times average width. In such recreational spaces a single storied building such as pavilion or gymnasium upto 25m2 in area may be permitted[2].)

Acoustics

The noise from the road cannot be heard in the classroom.

(As per the National Building Code of India main entrance to the plot shall be of adequate width to allow the fire engine and in no case shall measure less than 4.5 m[2]).

Classrooms

1 There is enough accommodation in the classrooms for all the students .
2 The infrastructure and planning able the students to move from one place to another with ease.
3 The first row students are able to see the board. Classrooms are located on one side of the corridor. Students sitting in one class are not able to see students in the other class.

(As per the National Building Code of India every room with a capacity of over 45 persons shall have at least 2 doorways. Exterior walls which are less than 90 cm from adjacent property lines shall have no openings therein. Also the ceiling height should be 3.6 m[2]).

Services

1 Has got all the fire fighting facilities like Sprinkler / Water Reservoir facilities / Fire Extinguisher / alarm System .
2 The staff is trained in Fire Fighting
3 There is the facility of a generator
4 There are provisions of water filters in each floor
5 There are separate exits in each floor such as 3 staircases and 1 lift

(As per the National Building Code provision shall be made for independent and ventilated meter room[3]).

Sick Room

There is a sick room in the campus which is easily accessible by all the students .

Landscape

1 There are enough pedestrian pathways
2 The maintenance and material are low cost
3 The planting is effective and beautiful

Green belts and landscaping

The National Building Code specifies

Where relief from noise is to be provided by means of greenbelts, these may be of considerable width and be landscaped, these may be of considerable width and be landscaped. The extent of relief that may be derived from the above may be estimated only after considering other environmental factors. Strong leafy trees may be planted to act as noise baffles. Shrubs or creepers may also be planted for additional protection between tree trunks, artificial moulds and banks should be formed wherever practicable.

A guide for the quantum of plantations of shrubs, trees and other greenery in different occupancies and community spaces is given below.

Educational Institutional

1 125 trees per hectare
2 50% of permissible open space for greenery

The types of plants, the distance between tree/ plants from the building and the distance between plants shall be carefully woked out keeping in view the structural safety and aesthetic requirement of building)[3]

A Model school has been prepared on an existing plot with all the necessary facilities of a school. The plot area of the site where the proposed school is to be built is 1.66 acres (67456sq mts).

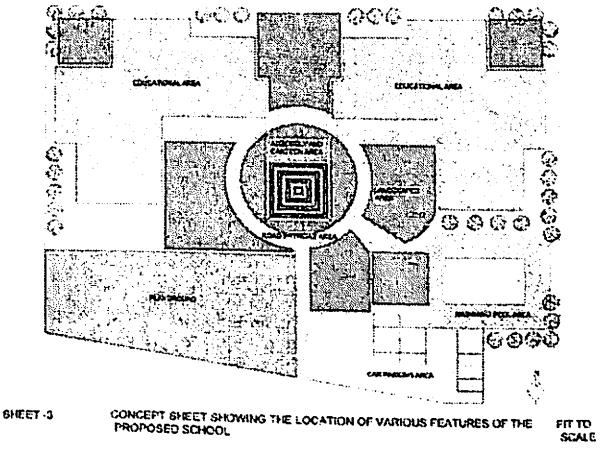


Fig : Concept Diagram

Features of the Design Concept

In this design the centralized theme is organized around the assembly and canteen area.

A Clustered Organization relies on physical proximity to relate its space to one another. It often consists of repetitive spaces that have similar

functions and share a common visual treat such as shape/orientation.

1 In a Clustered organization the spaces are clustered about a large defined field or volume of space.
2 The individual areas are all interconnected by this central space of activity area

The planning is done with the motive of using the site features to the best advantage as possible. The large playground on the left , helps to create a spacious environment and having a pool area on the right as one enters .Educational area is placed in accordance to having a grouped identity .The large assembly area is a focal point for the entire site.

The space defining elements are

1 Educational Area
2 Assembly and Canteen Area
3 Swimming pool area
4 Playground
5 Car parking

Principles of Design Employed

The principle of design is Symmetrical Balance. Symmetrical Balance as known results from the arrangement of identical ,elements, corresponding in shape,size,and relative position about a common line or axis. It is also known as axial or bilateral symmetry.

It results in a quiet ,restful and stable equilibrium that is readily apparent, especially when oriented on a vertical plane.

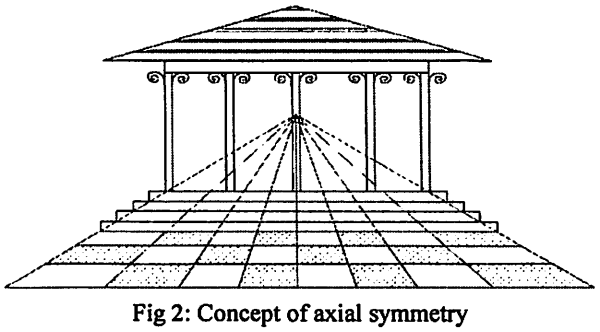


Fig 2: Concept of axial symmetry

The focus on termination of the axis is the assembly area shown in Fig 1.

A Number of symmetrical groupings can be arranged along an axis to form larger symmetrical organization. As discussed axial symmetry consists of a number of building patterns set together as shown in fig 2.

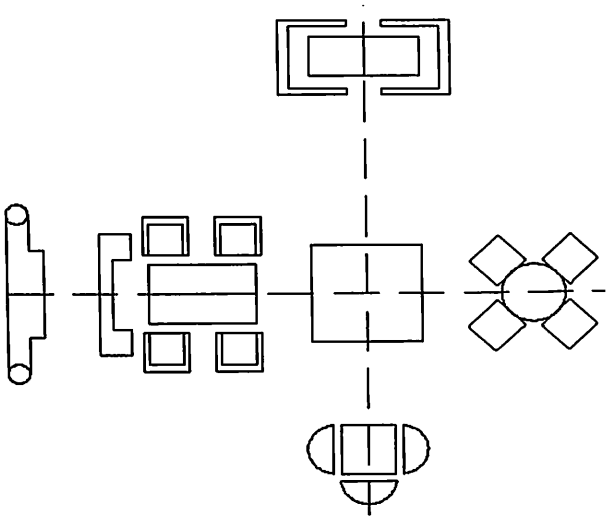


Fig 3: Expression of Balance

Capacity Of Proposed School is 1100 initially as proposed by the authority, However there are provisions for future expansions.

Elaborating On The Design Elements

1 Educational Area -Consists of two blocks for accommodation of the junior and senior sections.
2 Assembly and Canteen Area -The focal area of the design is present with the help of an assembly area on a raised platform where all the students assemble for their daily activities

The canteen is situated in the space which helps the students to utilize the covered assembly area during break as well as the playground also comes in use during break hours.

3 Swimming pool area -A 50 x30 ft pool allows for the school students to beat the heat and aid for extra curricular activity. It also completes the students need for a holistic environment. The sufficient changing rooms and shower areas aid to the needs of the swimmers.
4 Playground - A large open playground situated on the west of the site forms a platform for all outdoor facilities. It caters for the students physical health and gives a sense of openness as one enters the school premises.
5 Car parking – There is enough and adequate area for car parking of the staff as well as the student school buses. It is situated near the entrance and provides for easy movement.
6 Acoustics- The school is dotted with trees on the periphery to act as buffer trees and reduce noise conflicts
7 Orientation- The playgrounds are situated in the south west of the site due to considerations taken as this area being the best.

The junior block in the east has been given importance due to the amount of available sunshine necessary for the younger children

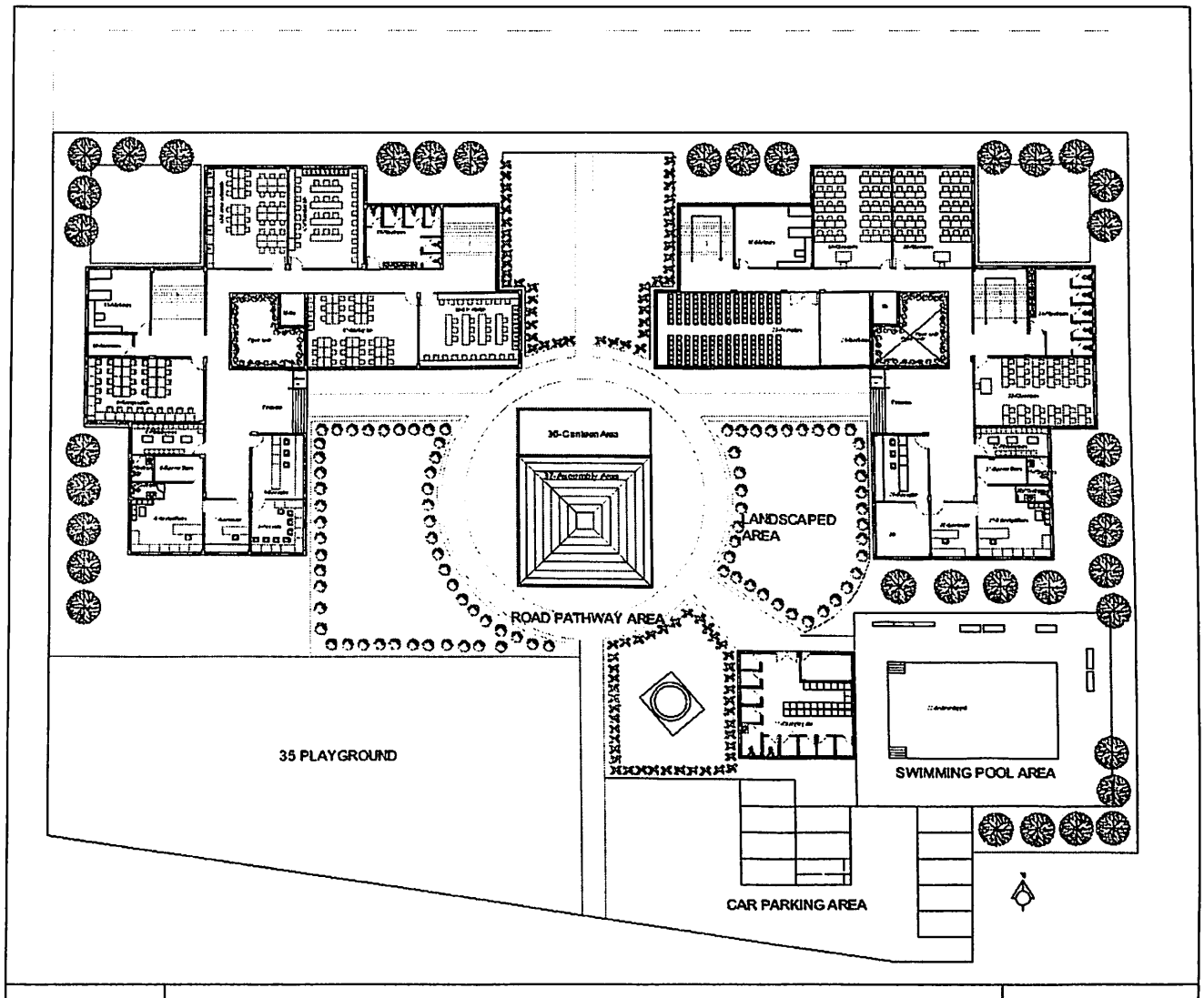
8 Pathways- A Walkway of 7 feet wide runs along to help the school's main external route. It leads to the different activity areas of the school campus and also interweaving them into one single learning environment. It forms the basic structure and holds all the the areas together. In short the pedestrian pathway is a pleasant experience that binds all the elements together.

9 Landscape Features- Large trees dotted along the periphery of the site act as buffer trees and allow for privacy and smooth acoustics. The trees also enhance the aesthetics of the school site. Small patches of gardens allow for increased visual comfort and add openness to the site.

The plan of the school is reflected by nature, where the designer has incorporated as much as openness and kept the whole school as close to nature. The greenery around makes one realize about the natural components the eye takes us to .The school is provided with a green courtyard which keeps the student connected with nature & emphasis learning.

In a nutshell the highlights of the design include

1. Planning around a central axis with bifurcation on both sides.
2. The focal point is the assembly area.
3. Along the four nodal points of the axis lies the junior school/senior school/swimming pool and the playground
4. In the core courtyard the breathtaking fresh green area is surrounded by a pedestrian pathway with their circular branches spreading out in four directions.



SHEET-5	GROUND FLOOR PLAN SHOWING LAYOUT OF THE SCHOOL	FIT TO SCALE

Fig 5: Site Plan Showing the Ground Floor of the Proposed School

LEGEND

1	Reception	16'x20'	18	Sickroom	23'x19'
2	Accounts	16'x16'	19	Classroom	23'x30.6'
3	Secretary	13.5'x16'	20	Classroom	23'x30.6'
4	Principal Room	22'x16'	21	Washroom	19'x27'
5	Washroom	9'x5'	22	Class room	35'x20'
6	Record Room	15'x7.10'	23	Waiting room	22'x10'
7	Washroom	6.5'x7.10'	24	Record Room	15'x7.10'
8	Waiting room	22'x10'	25	Washroom	6.5'x7.10'
9	Computer lab	35'x20'	26	Washroom	9'x5'
10	Storeroom	14'x7'	27	Principal Room	22'x16'
11	Sick room	19'x20'	28	Secretatary	13.5'x16'
12	Home science lab	23.6'x30.6'	29	Record room	16'x16'
13	Chemistry lab	23'x30.6'	30	Reception	16'x20'
14	Biology lab	26.6'x30'	31	Backstage	10'x30'
15	Physics lab	36.6'x30'	32	Auditorium	54'x30'
16	Lift	10'x8'	33	Swimming pool	50'x30'
17	Washroom	22'x20'	34	Changing area	32'x32'
			35	Playground	108'x70'
			36	Canteen Area	40'x21'
			37	Assembly Area	40'x40'

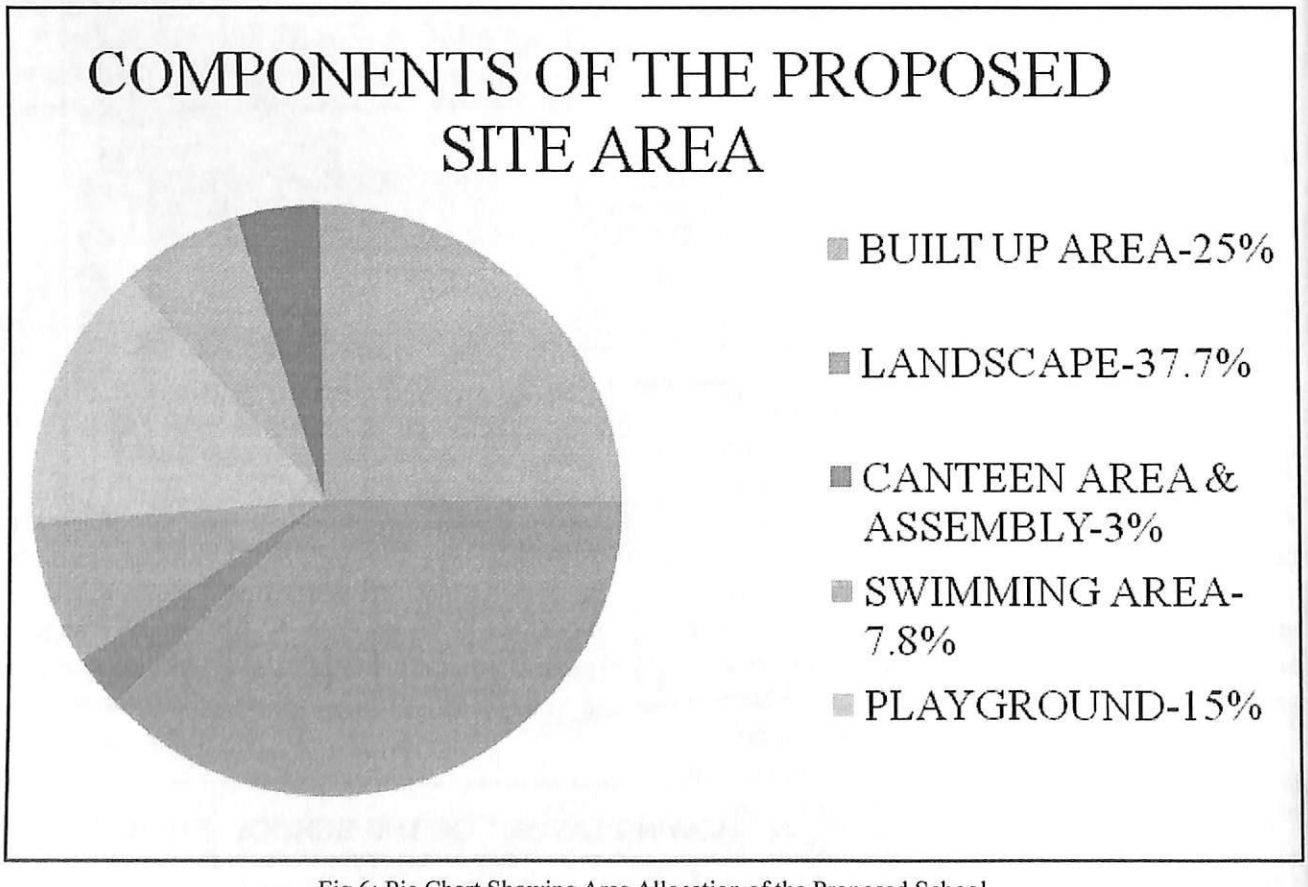


Fig 6: Pie Chart Showing Area Allocation of the Proposed School

Fig 1 - Broadly Dividing The Area Into Two Categories

1 Built Up Area-28%

2 Non-Built Up Area-72%

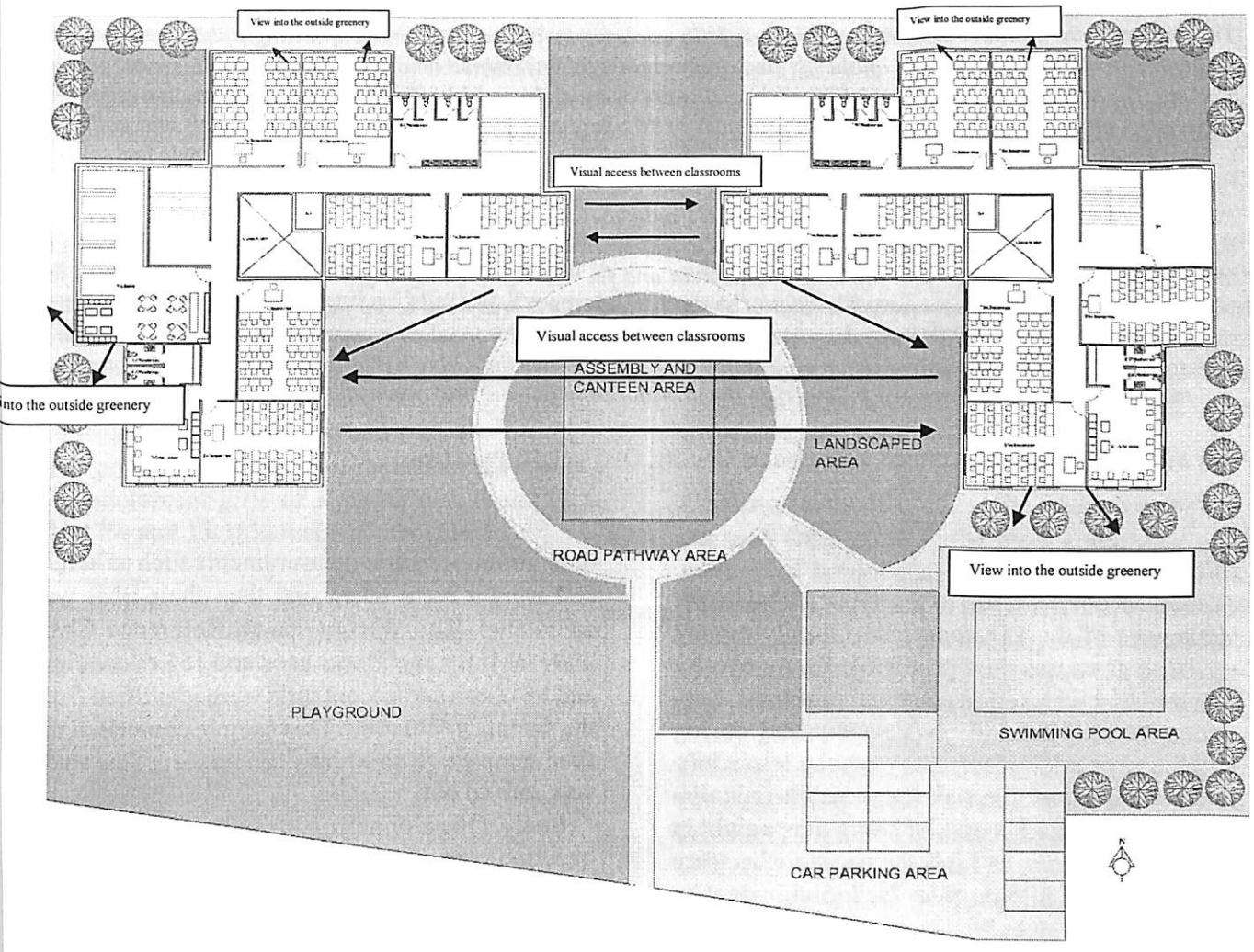


Fig 7: Site plan showing ground floor of school buildings/swimming pool and landscape

Conclusion

The design of school has evolved and has been moving towards providing comfort and advanced facilities to manage space efficiently, sufficient planning has been done to provide a proper environment for education.

There are several factors that guide in designing a school which not only forms a educational centre but also provides the environment for nurturing a student's academic years. These factors have been found out to be followed and necessary for designing the school facilities.

It was an intense study to observe the facilities of the school and to identify the ideal design features that makes learning an enjoyable exercise. With the help of broad designing guidelines a proposed model school layout shows the features and facilities of proper space planning.

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A Study on Prevalence of Overweight and Obesity among Adolescent Girls in Kolkata

Sukhpreet Kaur and Alifiya Nomanbhoy

ABSTRACT

The unabated rise in the prevalence of overweight in adolescents is one of the most alarming public health issues facing the world. The prevalence of obesity and overweight was determined among 732 affluent adolescent girls of Kolkata. The results indicated that 21.17% of the girls were overweight and 13.38% were obese. Information regarding knowledge, attitude and dietary & lifestyle practices of 98 obese and 155 overweight adolescent girls was collected using a structured questionnaire. It was seen that although 49% of the adolescent girls had fair knowledge, and all the subjects had positive attitudes towards nutrition and healthy lifestyle, a negative correlation was seen between Knowledge and Practice; and Attitude and Practice. Faulty dietary practices such as frequent consumption of energy dense, high calorie food and drinks and physical inactivity were seen to be the main causes of obesity and overweight in the girls. It was also seen that the intake of protein and fat was significantly higher ($p<0.05$) than the RDA for obese and overweight adolescents. The diet of the adolescent girls was seen to be deficit in calcium and iron. A significant difference ($p< 0.05$) was seen in the intake of calcium and iron when compared to the RDA. Thus, these findings suggest the need for intervention programs which will improve the eating habits and lifestyle of the adolescents and this may act as a step forward in lowering the prevalence of obesity and overweight in the near future.

Keywords- Adolescence, Attitude, Knowledge, Obesity, Overweight, Practices

Introduction

Adolescent obesity is one of the major global health challenges of the 21st century[6]. Obesity among adolescents causes dual problems; firstly obesity is associated with serious medical problems. Secondly, overweight and obesity acquired during childhood or adolescence may persist into adulthood and increase the risk for some chronic diseases later in life. The risk of being overweight in adulthood is twice as high for people who were overweight as children than for individuals who were not overweight[12].

Due to rapid urbanization and lifestyle modification, prevalence of obesity among children and adolescents is also increasing in the developing world like India. While this global epidemic is well described in the adult population, not much data is available regarding the prevalence of overweight/ obesity in children or adolescents amongst developing countries. In India the problem of obesity has been scantily explored even in affluent population groups[11]. Identification of risk factors, prevention and management of childhood and adolescent overweight is the key for prevention of obesity and its consequences in adult life[10].

Methodology

Sampling- The present study was conducted on adolescent girls in the age group of 11-14 years from two schools of Kolkata city which were catering to the affluent segment of the population[1]. In order to determine the prevalence of overweight and obesity, 732 adolescent girls were selected and their anthropometric measurements such as height and weight were taken and then their BMI was calculated. The WHO Growth Reference Chart 2007 BMI for age[20] was used and 155 overweight and 98 obese adolescent girls were identified from the sample population. This sample comprised the final sample size on which the next part of the study was carried out.

Study Questionnaire- A pre-tested structured questionnaire aimed at attaining information in order to assess the knowledge, attitude and practices relating to lifestyle and eating habits of the overweight and obese adolescent girls was administered. The responses to the knowledge questions were scored as follows: 'Agree' was scored as +1, 'Disagree' as -1 and 'Not sure/I don't know' as 0. The maximum scores obtained in knowledge questionnaire were estimated for the respondents. Scores of more than 75% of the maximum were considered 'good'; score of 50-75% was considered 'fair' and scores lower than 50% were considered 'poor'[13]. The attitude section had 9 statements of the 5-point Likert type format. The response to the Attitude statements were scored as follows: Strongly Agree as +5, Agree as +4, Undecided as +3, Disagree as +2, Strongly Disagree as +1. The highest score that could be received was 45 and the lowest score could be 9. The Practice questions were scored by assigning the highest score to the best practice. The dietary habits and the nutrient intake of the subjects was determined using food frequency questionnaire and 3-day dietary recall method.

Data Collection-The questionnaire was self-administered by the overweight and obese adolescent girls.

Statistical analysis-The correlation coefficients were calculated which helped in determining that whether there was any association between knowledge and practice and; attitude and practice. The t-statistics was done to see whether the macronutrient and micronutrient intake of the overweight and obese adolescent girls was meeting the Recommended Dietary Allowance (RDA) requirement as specified by Indian Council of Medical Research (ICMR).

Results and Discussions

Prevalence of Overweight and Obesity

The prevalence of overweight and obesity among the adolescent girls of Kolkata was found to be 21.17% and 13.38% respectively (Fig 1).

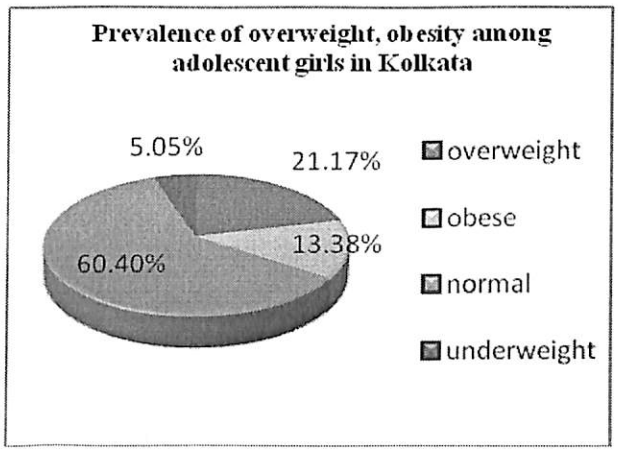

Fig 1: Prevalence of overweight, obesity among adolescent girls in Kolkata

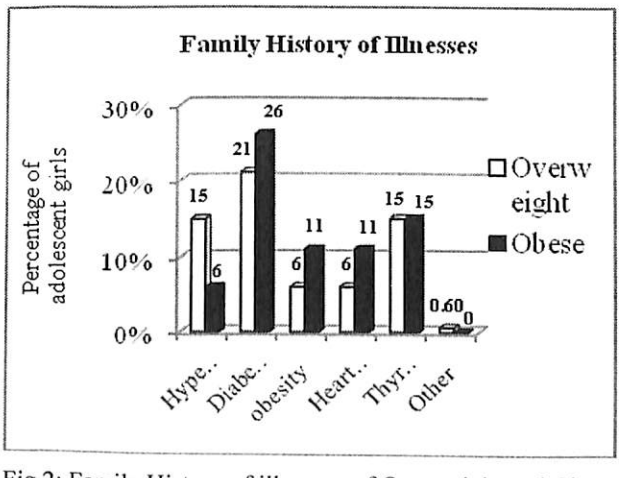

Fig 2: Family History of illnesses of Overweight and Obese adolescent girls

The findings are similar to a study done in Chennai where the prevalence of obesity and overweight amongst adolescent girls from upper socio-economic status was found to be 22% and 11.3% respectively[19].

Family History of Illnesses

Family history is a strong factor for the child being obese. Research shows that children who have one or two obese parents are more likely to be obese as adults[17]. From Fig 2 we can see that 6% of overweight and 11% of obese adolescent girls have family history of obesity. It was seen that 15% of overweight and 15% of obese adolescent girls had family history of thyroidism. The overweight and obese adolescent girls also have family history of type 2 diabetes, hypertension and heart disease which poses for them a greater risk of developing these diseases in the near future.

Cooking Methods used for the Food Consumed

As seen from table 1, the most commonly used method of cooking the food items eaten by the adolescents was seen to be frying (50%). Healthy cooking practices were used by very few adolescents- steaming (11%), roasting (7%), and grilling (4%). According to Annual Report of ICMR (2003-2004) the prevalence of overweight and obesity was higher in the children who consumed fatty and fried foods[15]. Fried foods are crunchy, aromatic, highly palatable, and rich in fats. As a consequence, eating fried food in ad libitum conditions may result in higher absolute intake of foods with high energy density and low satiety index[3].

Table 1. Cooking Methods used by Adolescent Girls

Cooking methods used	Percentage of adolescent girls
Baked	24%
Fried	50%
Steamed	11%
Roasted	7%
Grilled	4%

Table 2. Frequency of Eating Out by Adolescent Girls

Frequency of eating out	Percentage of adolescent girls
Daily	27%
3-4 times a week	46%
Once a week	11%
Once a month	8%
Twice a month	6%

Frequency of Eating Out

Eating out has become a trend these days especially in youngsters[1]. It is seen in the present study that

about 27% of overweight and obese adolescent girls ate out daily and about 46% of girls ate out 3-4 times per week (Table 2). Amin et al[15] has also reported that frequency of eating food outside home was high among overweight and obese children; 5 times per week or more. The types of food commonly consumed as snacks outside home are often high in fat or high in carbohydrates(sugar and/or starch), which contributes to the prevalence of obesity[1].

Physical Activity Pattern

About 54% of overweight and obese adolescent girls did physical activity only once in a week and only 19% of them performed daily. From table 3 we see that 43% of adolescent girls spent only about ½ hour on physical activity while only 17% of them spent more than 1 hour. Globally more people are driven by technology based, comfort oriented lifestyles, resulting in changes in the activity patterns of children towards more sedentary living. Many children fail to exercise or devote less time to exercise as they are spending time doing sedentary activities such as using computers, playing video games or watching television[2]. This trend can also be seen in the present study (Table 3).

Table 3. Physical Activity Pattern of Overweight and Obese Adolescent Girls

Time spent on physical activity	Percentage of adolescent girls	Time spent on watching T.V. and Computer			
		T.V. viewing	Percentage of adolescent girls	Computer Viewing	Percentage of adolescent girls
½ hour	43%	< 1 hour/day	13%	< 1 hour/day	6%
½ - 1 hour	19%	1-2 hours/day	22%	1-2 hours/day	18%
>1 hour	17%	3-4 hours/day	42%	3-4 hours/day	39%
0 hour	21%	5-6 hours/day	21%	5-6 hours/day	31%
		7-8 hours/day	2%	7-8 hours/day	6%

About 42% of overweight and obese adolescent girls were spending 3-4 hours watching T.V; while 39% of the girls spent their time surfing or playing on computer. Dennise et al reported that children who watched 4 or more hours of T.V. per day had significantly greater BMI, compared with those watching fewer than 2 hours per day[9]. Watching television has been linked with an unhealthy diet and obesity. This may be influenced by unhealthy nutrition messages in commercials and eating snack foods while watching television[18].

Knowledge, Attitude and Practice of Overweight and Obese Adolescent Girls

About 20% of adolescent girls had poor knowledge score, 49% had fair knowledge score and 31% had good knowledge level. In the present study all the adolescent girls were seen to have the attitude score greater than neutral point, thus it can be concluded that all the obese and overweight adolescent girls had positive attitude towards nutrition and physical activity.

Table 4. Correlation of Knowledge, Attitude and Practice of Obese and Overweight Adolescent Girls

Variable	Value of r	Significant/Not significant
Attitude, Practice	-0.0163	Not significant
Knowledge, Practice	-0.06287	Not significant

The correlation coefficient of attitude and practice is -0.0163 while that of knowledge and practice is -0.06287. The correlation coefficient value for both the variables is significantly less and it was observed that in both the cases the value of the computed t-statistics turned out to be less than the tabulated value. This means the association between attitude and practice; knowledge and practice are not significant. Thus there is absence of significant correlation between knowledge and practice; attitude and practice. However the negative sign of 'r' indicates that attitude and practice; knowledge and practice are negatively correlated. This means that the practices of the overweight and obese adolescent girls are being influenced by factors other than their knowledge and attitude.

Frequency of Consumption of Different Food Items

From table 5 it can be seen that the daily consumption of soft drinks, white bread, junk foods was high among adolescents while the daily consumption of food items like brown bread, oats, leafy vegetables and fruits, was low among adolescent girls.

The majority of the adolescents were seen to be consuming refined carbohydrates in the form of white bread daily while the consumption of complex carbohydrates such as brown bread and oats was almost negligible. Complex carbohydrates should be included in the diet because the high bulky fibre of these foods satisfies hunger with fewer calories while, a low bulk, high calorie, sugary diet encourages hunger and gorging. Such a diet promotes consumption of far more calories before satiety is achieved[14].

Table 5. Frequency of Consumption of Different Food Items

	Daily	4-5 times/ week	2-3 times/ week	Once a week	2-3times/ month	Once a month	Rarely	Never
White Bread	48%	30%	15%	5%	2%	0%	0%	0%
Brown Bread	0%	3%	23%	10%	31%	11%	9%	11%
Oats	0%	0%	1%	1%	3%	3%	30%	62%
Leafy Vegetables	7%	2%	18%	53%	9%	2%	2%	1%
Fruits	7%	8%	15%	22%	17%	13%	15%	-
Whole milk	9%	31%	35%	12%	1%	5%	6%	-
Soft drinks	38%	28%	13%	10%	3%	3%	2%	1%
Junk foods (Pizza, Burger, Chips, Instant Noodles, Biscuits)	36%	32%	17%	6%	5%	2%	1%	1%

The adolescent girls preferred consuming soft drinks (38%) daily instead of milk (9%). Consumption of sugar sweetened drinks, particularly soft drinks is associated with obesity in children. Ludwig et al found that for each daily serving of sugar sweetened drink consumed the odds ratio of becoming obese among children increased by a factor of 1.6. Also, it is seen that consumption of soft drinks is associated with a higher overall total energy intake[4].

Since the consumption of junk foods was high in the study group it is believed to be an important reason for development of obesity. This is so because these foods are high in salt and are energy-dense. Junk food can become energy dense from either sugar or fat[21]. Many high-fat foods are preferred presumably because of the mouth feel characteristics that fats and oils impart[8].

Dietary Intake of Macronutrients and Micronutrients

From the table 6 it can be seen that there was no significant difference ($p>0.05$) in mean daily energy intake when compared to RDA for 11-12 year overweight and obese adolescents and 13-14 year old obese adolescent girls. The mean energy intake of 11-12 year old met 101% of the RDA for both overweight and obese adolescent girls.

There was significant difference ($p<0.05$) in the mean daily energy intake when compared to RDA for 13-14 year old overweight adolescents. The mean energy intake of 13-14 year old overweight and obese adolescent girls met 97% and 99% of the RDA respectively.

Table 6. Dietary Intake of Macronutrients and Micronutrients by 11-12 year old and 13-14 year old Overweight and Obese Adolescent Girls

Nu trient	Category	RDA		Mean intake		S.E.		Computed value of t-statistic	
		11-12 year	13-14 year	11-12 year	13-14 year	11-12 year	13-14 year	11-12 year	13-14 year
Energy (kcals)	Overweight	2010	2330	2039.20	2261.33	265.1	168.9	0.90	-3.2
	Obese	2010	2330	2033.29	2314.62	277.7	152.0	0.59	-0.57
Protein (gms)	Overweight	40.4	51.9	55.18	59.74	11.08	7.65	10.95	8.08
	Obese	40.4	51.9	56.61	63.04	11.88	8.94	9.65	7.05
Fat (gms)	Overweight	35	40	61.21	72.34	13.17	9.14	16.28	27.88
	Obese	35	40	64.43	66.48	10.76	8.11	19.36	18.52
Carbo-hydrate	Overweight	351.75	407.75	321.48	348.46	53.97	39.70	-4.61	-11.70
	Obese	351.75	407.75	312.05	373.47	53.81	30.07	-5.03	-6.46
Calcium (mg)	Overweight	800	800	579.05	590.76	339.7	272.9	-5.33	-6.03
	Obese	800	800	545.75	509.76	287.3	284.4	-6.26	-5.78
Iron (mg)	Overweight	27	27	10.78	10.82	3.87	3.35	-34.51	-37.63
	Obese	27	27	9.81	10.75	3.38	3.25	-35.81	-28.5

There was significant difference ($p<0.05$) in the mean daily protein and fat intake when compared to RDA for all the adolescents. The protein and fat intake was seen to be in excess of the RDA in the adolescents of all the age groups. When protein is consumed in excess of needs, it is diverted to energy pathway, or if it is above calorie needs it is metabolized into fat[6]. High fat diets are more likely to result in body fat accumulation than the diets which are high in carbohydrates. High fat diets are by nature adipogenic and could be a cause of the overweight found in the adolescent overweight group[5].

There was significant difference ($p<0.05$) in the mean daily carbohydrate, calcium and iron intake when compared to RDA for all the adolescents. The carbohydrate, calcium and iron intake was in deficit of the RDA requirement in the adolescents of all the age groups. It is said that micronutrient deficiencies are caused due to a high intake of energy-dense foods that do not contain vitamins and minerals[16]. In the present study also, it was seen that the adolescents had a high intake of energy dense foods which could lead to low dietary intake of micronutrients like calcium and iron.

Conclusion

Looking at the current scenario and the recent studies that are being done, the prevalence of obesity in urban societies is showing an upward trend. In the present study frequently eating out, improper cooking practices, consumption of junk foods, wrong food choices, and physical inactivity were seen to be the contributing causes to the development of obesity in adolescents. It was seen that the obese and overweight adolescents were deriving greater percentage of their energy from protein, fat and lower from carbohydrates. The diet of the adolescents was also seen to be deficient in the micro-

nutrients, calcium and iron. It was seen that the Practices of the obese and overweight adolescent girls were not being influenced by their Knowledge and Attitude but some other factors maybe involed. Obesity is a complex disease which needs a multidimensional approach for its management. The need of the hour in developing countries is to tackle obesity at an early age, by advocating life style modifications and nutrition education. The nutrition education programme would be one step forward to promote healthy eating among the adolescents so as to help and influence the trend in developing countries towards a healthy adulthood and a healthy world.

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A Study on the Nutritional Status of Beneficiaries of Mid-Day Meal Programme

Tannistha Pathak and Pratyasha Agrawal

ABSTRACT

A study was carried out to evaluate the nutrient adequacy of Mid Day Meal among 200 school children (100 girls and 100 boys), 7-9 years of age from the 6 Low Income Group schools in Kolkata. A three day dietary survey of Mid Day Meal as well as the whole day's nutrient intake, and anthropometric measurements of the children revealed that almost 70% of the children had normal height, weight, MUAC for age where as near about 30% children were suffering from malnutrition. Fruits and vegetables, dairy product consumption was less than normal requirement. Roadside food consumption increased the risk of diarrhea and leads to malnutrition due to lack of hygiene. Clinical deficiencies like easy to pluck hair; white spots on nails and rough skin were observed in most of the children. The statistical analysis of each nutrient by 't' test for whole day as well as for Mid Day Meal revealed that the mean macronutrient intake were deficient in children as compared to their RDA requirement. In case of Mid Day Meal except protein no other nutrient requirement was met which indicated that Mid Day Meal was not nutritionally adequate.

Keywords: Clinical deficiencies, Malnutrition, Mid Day Meal, School Children.

Introduction

Childhood is the period when the child is expected to learn the rudiments of knowledge that are essential for successful adjustments to adult life. Poor dietary habits during childhood may affect day-to-day well being and performance, growth and development, dental health and increase likelihood of iron-deficiency anemia. In addition, poor childhood nutrition may increase the risks of chronic diet-related diseases such as ischemic heart disease and cancer[3].

Children who grow up in environments where their developmental needs are not met are at an increased risk for compromised health and safety, and learning and developmental delays. Failure to invest time and resources during children's early years may have long term effects on the foster care, health care, and education systems. Therefore, it is in the public's interest to ensure that children develop in safe, loving, and secure environments.

School lunch plays an important role in preventing malnutrition in the school going children. Since children spend a lot of time in school, it is important that they eat a healthy meal in school to avoid malnutrition. A school lunch should provide 1/3rd of the daily nutrient requirement of the children.

The Government of India on 15th of August 1995 started a scheme called Mid-Day Meal on the recommendation of National School Health Committee. Mid-Day Meal (MDM) involves provision of lunch free of cost to school children on all working days. Government standards for school meals were reintroduced in 2001, which specified that fruits and vegetables, low-fat starch and dairy foods and protein rich foods must be offered to children every day. A school lunch is a meal (usually lunch) provided to students at a school. It is usually served sometime around noon; however, many schools also serve breakfast before classes begin in the mornings[13].

The Mid-Day- Meals provide children with at least one nutritionally adequate meal a day which should contribute to 1/3rd of the child's daily requirements so that it can help to improve attention and class performance. The meal should be prepared from special foods, such as Balahar (Soya fortified bread). The meals should be based on a combination of cereals, pulses and leafy vegetables. Eggs must be given once a week[13].

Malnutrition may result, if children do not eat properly in school, as the lunch eaten in school should provide 1/3rd of the daily requirement of calories and protein. Therefore a lot of emphasis has to be put on their packed lunches or the meal they have in school[13].

Methodology

Selection of Place:

The children were selected from six schools in Kolkata, two from north, two middle and two from south Kolkata namely Pranabananda Vidyamandir, Binapani Primary school, Muraripukur Govt High School, Deshopriyo Balika Vidyamandir, Bullygunge Govt High School and United Missionary Girls High School.

Selection of sample:

Students were selected from six different schools with the help of purposive sampling method. Out of 200 children, 100 girls (25 girls each from

Pranabananda Vidyamandir , Binapani Primary School, Deshopriyo Balika Vidyamandir and United Missionary Girls High School respectively) and 100 boys (25 boys each from Pranabananda Vidyamandir, Binapani Primary School Muraripukur Govt High School and Bullygunge Govt High School respectively) were selected from the middle-low income group schools.

Standardization of the recipes:
The most common recipes (in different proportions) like rice, dal, vegetables, chapattis of different sizes and volumes were standardized in terms of measuring cups, glasses and spoons in the food laboratory of J.D Birla Institute. Rice, dal, currys were put in 3 different sizes of bowls (small, medium, large) and the different shapes and sizes of chapatti cut out on paper were shown to the children from which they could select, the one similar to the amount they have consumed.

Construction of questionnaire:
The questionnaire aimed at attaining the relevant information regarding the personal details, anthropometric measurements, clinical assessment and the dietary pattern of the children. The questionnaire was divided into V parts.

Part I: Personal Details: This part dealt with detailed general information about the children such as their name, age, and date of birth, sex, address etc.

Part II: Anthropometric measurements: The anthropometric measurements commonly used as indices of growth and development for children include length and weight. Height was measured with the help of a stadiometer and weight was taken by a portable human weighing machine with an accuracy of 0.5 kg. Mid Upper Arm Circumference was taken with the help of measuring tape.

Part III: Clinical Information: Different body parts of the children like hair, eyes, tongue, nails and their skin were diagnosed by naked eye.

Part IV:Eating pattern of the children: Eating patterns of the children were probed to find out the kind and the quality of food consumed.

Part V: Three day dietary recall: 3 working days were taken into consideration. the children were shown the standardized glasses, cups, spoons, katoris and different sized chapattis etc from which they could select the one similar to the amount they have consumed.

Results and Discussion

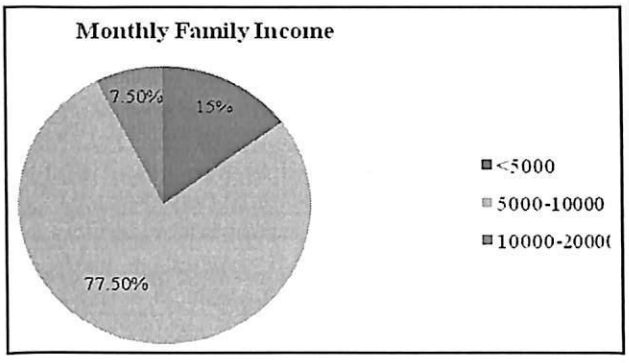

Fig 1: Pie graph showing the monthly family income of the Mid-Day Meal beneficiaries

All the children receiving Mid-Day Meal belonged to the low income group families. Their standard of living was poor and the monthly income was not enough to support the family. They did not have knowledge of healthy eating habits and good nutrition. Due to these reasons children were neglected very much.

A research carried out in rural Bihar to assess the nutritional status of school children has shown that due to poor socio- economic condition that leads to poor purchasing power, and also due to illiteracy and ignorance of the parents, children consume less amount of food which leads to malnutrition[6].

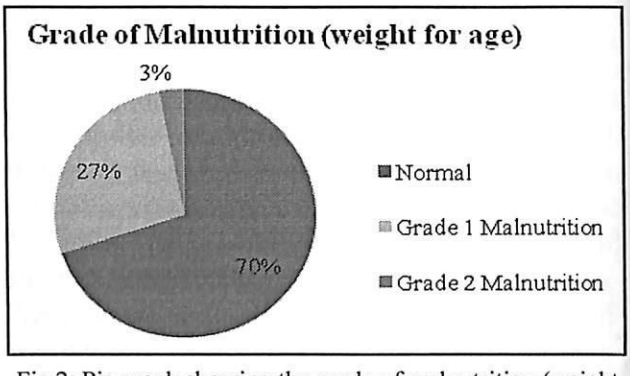

Fig 2: Pie graph showing the grade of malnutrition (weight for age) of Mid-Day Meal beneficiaries

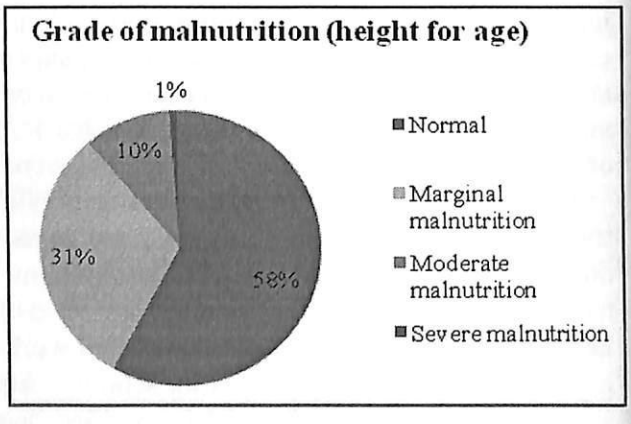

Fig 3: Pie graph showing the grade of malnutrition (height for age) of Mid-Day Meal beneficiaries

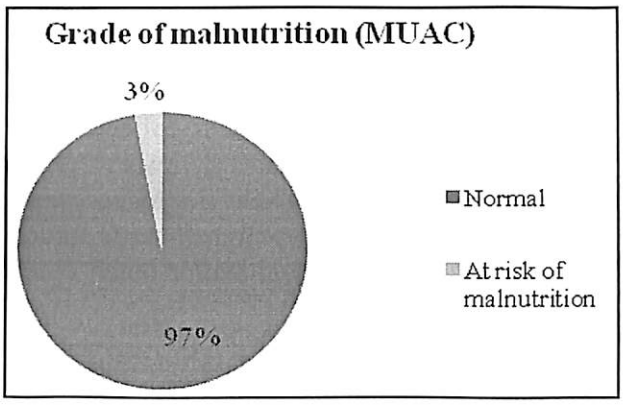

Fig 4: Pie graph showing the grade of malnutrition (Mid Upper Arm Circumference) of the Mid-Day Meal beneficiaries

In case of weight for age, 70% of the school children had normal weight for their age. But 27% of school children were suffering from Grade I malnutrition and 3% were suffering from Grade II malnutrition. In case of height for age, 58% of the school children had normal height for their age. But 31% of school children were suffering from marginal malnutrition, 10% were suffering from moderate malnutrition and 1% school children were suffering from severe malnutrition. In case of mid upper arm circumference, 97% children were under normal condition but 3% children were at risk of malnutrition.

A study has been done on 3747 school children in Haryana to determine the nutritional status of those children. Age, weight, height and MUAC of children were recorded. It was seen that 38.8% children were stunted, 39.6% were underweight and 9.1% were wasted whereas 12.5% children had neither wasting nor stunting. Prevalence of severe stunting, underweight, and wasting was 18.1%, 11.5% and 0.6%, respectively. The MUAC of most of the children was <13cm. Study concluded that almost every second child was undernourished[5].

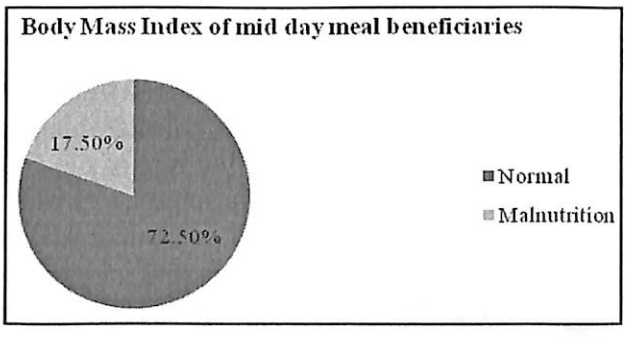

Fig 5. Pie graph showing the Body Mass Index of the Mid-Day Meal beneficiaries

In case of body mass index, 72.5% children were under normal condition while17.5% children were malnourished. This can be again due to low intake of nutrients. Also there was lack of knowledge about good nutrition and ignorance which affects child's health.

Anthropometric assessments of school age children in Addis Ababa were carried out. The results showed prevalence of thinness was 28.4% for boys and 20.4% for girls; the average being 24%. The prevalence of stunting (< 3rd percentile) was 13.8% for boys and 6.2% for girls with an average of 9.8% for both sexes and their BMI was lower than the normal[17].

As school age period is a steady growth period, poverty, ignorance and lack of knowledge leads to the malnourishment in the children.

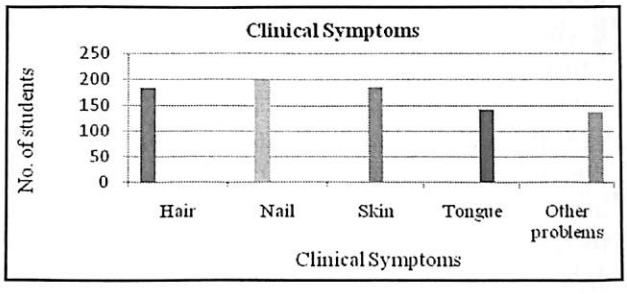

Fig 6. Bar graph showing the clinical symptoms of the Mid-Day Meal beneficiaries

Most of the children had skin, nail and hair problems. Skin problems could be attributed to deficiency of micronutrients like vitamin A and C where as hair problems could be due to deficiency of iron in the diet. This could be due to low intake of fruits and vegetables in their diet. Apart from this their consumption of green leafy vegetables as well milk and milk products was also low.

A study conducted to see the impact of micronutrients deficiency on the skin of children which showed that cutaneous changes occur in deficiency states of many nutritional elements like ascorbic acid, retinol, protein-energy, cyanocobalamin, phytonadione (vitamin K), biotin, riboflavin, pyridoxine, niacin, essential fatty acids, and zinc[14].

Another study has shown that iron (involved in many critical physiologic processes within the hair follicle) deficiency in school children leads to hair problem (mainly easy to pluck)[2].

A study conducted on 159 children to see whether calcium deficiency had any effect on finger nails. Finger nails were assessed with active absorption spectrophotometry and serum calcium level was assessed. It was seen that children had nail problems and they also had low serum calcium level. It has been concluded that calcium deficiency could be the reason for finger nail problems[1].

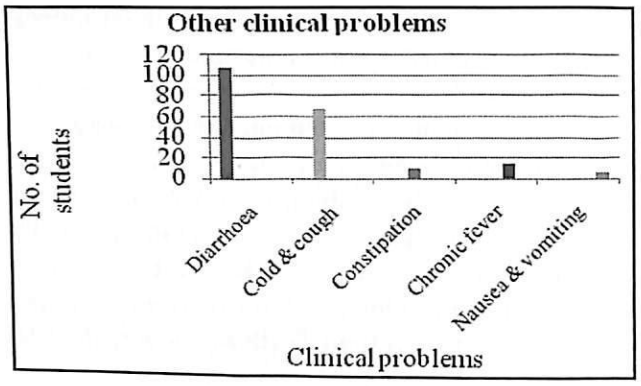

Fig 7. Bar graph showing the other clinical problems of the Mid-Day Meal beneficiaries

Prevalence of diarrhea and cold and cough was seen in children. Improper maintenance of hygiene and consumption of roadside foods could be the major causes of diarrhea in the children.

A study was conducted among 664 school children in the age group of 6-10 years in order to estimate the prevalence of gastro intestinal tract infections and their effect on nutritional status. Diarrhea and infections were most prevalent in populations with low household income, poor handling of personal and environmental sanitation, overcrowding, and limited access to clean water. About 47% of the subjects were found to have diarrhea and 17.1% of the subjects were found to have infection. And it was also found that approximately 12.3% of the students were stunted, 19.6% were wasted, and 20.8% were underweight, which was due to diarrhea and infection[9].

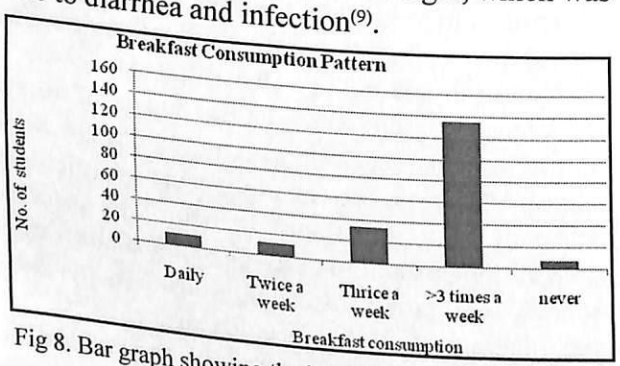

Fig 8. Bar graph showing the breakfast consumption pattern of the Mid-Day Meal beneficiaries

Most of the children (67.5%) ate breakfast more than 3 times a day. Some students even ate breakfast 3 times (17%) and 2 times (6%) in a week while some students (4%) skipped breakfast. Very few students (5.5%) ate breakfast regularly.

Children who eat a good breakfast tend to perform better in school, and have a better attendance and decreased hyperactivity. On the other hand children who do not eat their breakfast tend to perform not as well, and also tend to have behavior problems such as fighting, stealing, and not listening to their teachers[10].

A study was conducted in which data on breakfast and lunch consumption was collected using an in-classroom questionnaire. χ^2 tests were used to compare skipping meal behavior by geographic location. Twenty percent of fourth-grade students reported skipping breakfast and/or lunch at least three times per week[15].

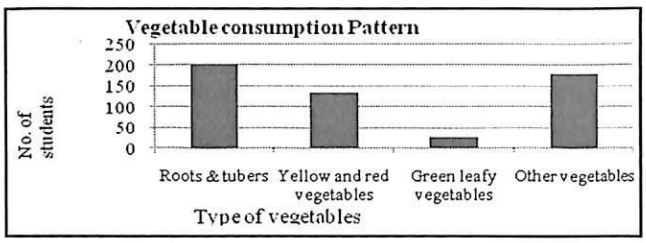

Fig 9. Bar graph showing the pattern of vegetable consumption of the Mid-Day Meal beneficiaries

All children consumed roots and tubers mainly potato because it was cheap. They also consumed red and yellow vegetables mainly pumpkin and tomato and other vegetables like brinjal, lauki, cauliflower. But only 10% of the children consumed green leafy vegetables due to low purchasing power.

A study conducted on 134 school children to assess their vegetable consumption pattern revealed that their diet was mostly comprised of potato and tomato with minimum inclusion of vegetables like carrot, spinach and green peas[11].

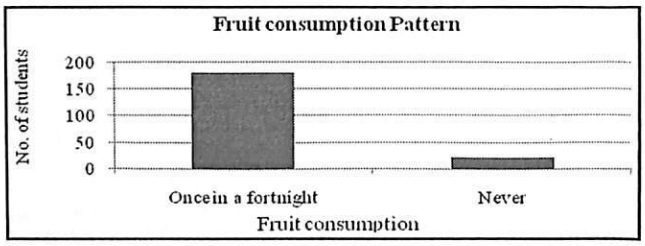

Fig .10. Bar graph showing the pattern of fruit consumption of the Mid-Day Meal beneficiaries

Most of the children (89.5%) consumed fruits once in a fortnight and that too guava, banana which are cheaper than the other fruits but rest of the children (10.5%) did not even consume fruits which could be the reason for vitamin and minerals deficiency. Due to lack of vitamins and minerals in their diet the energy they were taking from different foods was not being utilized properly since vitamins and minerals are required as co-factors in the metabolism of carbohydrate, protein, fat and most importantly energy.

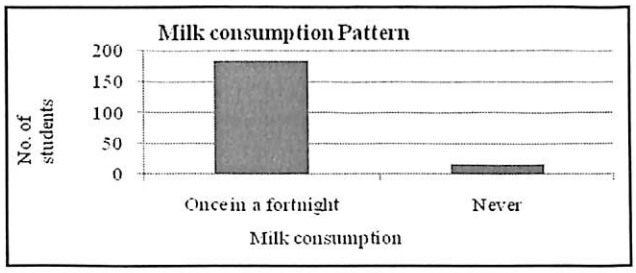

Fig 11. Bar graph showing the pattern of milk consumption of the Mid-Day Meal beneficiaries

Most of the children (91.5%) consumed milk or milk products once in a fortnight but others did not consuming milk at all. Milk is a good source of calcium and protein. Childhood is a period of steady growth. Milk is required for the bone, teeth, and nail formation. As children consumed milk once in a fortnight or never, every child had a common problem i.e. nail problem.

Another study was conducted to evaluate the relation between calcium intake and bone mass in 76 children. Children were divided into 2 groups. Group I comprised of children who were having milk and its products while Group II comprised of children who were not having milk and milk products. After 8 months it was found that the bone mineral content and the bone mineral density of the lumbar spine was less in Group II children when compared to Group I[8,12].

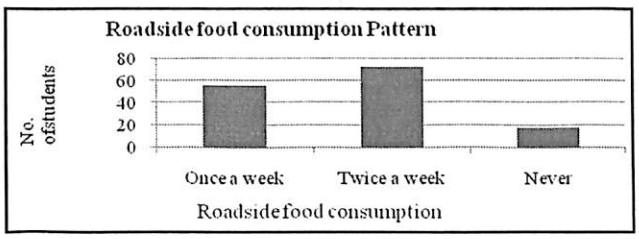

Fig 12. Bar graph showing the pattern of roadside food consumption of the Mid-Day Meal beneficiaries

Majority of the children consumed roadside food twice in a week mostly egg roll and aloo chop which were not prepared in a hygienic manner resulting in infections like diarrhea.

A study was conducted on 600 school children in which it has been seen that unhygienic food and inadequate access to clean water lead to hookworm infection which was associated with anemia and malnutrition[7].

Table 1: The mean nutrient intake of the Mid-Day Meal beneficiaries

Nutrients	RDARequirement	Intake
Protein (gm)	29.5	25.7386
Fat (gm)	43.2	29.11035
Carbohydrate (gm)	295.75	219.2118
Energy(Kcal)	1690	1345.21

There was significant difference between the actual consumption of nutrients and the RDA values. It could be due to inadequate intake of foods, as these children did not include enough fruits, vegetables and dairy products in their diet. Other than that improper maintenance of hygiene, lack of knowledge about health and good nutrition also hampered the digestion and absorption of nutrients in body which lead to health problems thus affecting their overall health.

A study showed that children from lower socio economic classes and larger families had lower daily nutrient intake. They were more likely to have less than the recommended daily intake of calcium and riboflavin[4].

Table .2. The statistical analysis of nutrient intake of the Mid-Day Meal beneficiaries for whole day

Nutrients	RDA	Intake					
		Pranab-ananda Vidya-mandir	Binapani Primary School	Murari-pukur Govt High School	Desho-priyo Balika Vidya-mandir	Bally-gunge Govt High School	United Mission-ary Girls High Schoo
Protein (gm)	9.8 gm	12.61gm	12.34gm	12.37gm	13.28gm	12.63gm	12.04gm
Fat (gm)	14.4 gm	12.38gm	12.40gm	12.41gm	10.72gm	12.35gm	7.03gm
Carbohydrate (gm)	98.65 gm	70.64gm	412.8	346.46	399.35	354.33	406.6
Energy (KCal)	563 (KCal)	414.3 (KCal)	412.8 (KCal)	346.46 (KCal)	399.35 (KCal)	354.33 (KCal)	406.6 (KCal)

No nutrient requirements were met other than that of the protein through Mid-Day Meal. In week days (from Monday to Friday) Mid-Day Meal comprised of 50-60 gm of cereal, 25-40 gm of pulses, 100 gm of potato and seasonal vegetables while egg was given once a week. Some schools provided dry foods like cakes and biscuits on Saturdays. To encourage the food intake of the children different types of meals were provided. Cereals and pulses were provided as steamed rice with dal or as khichri. Potatoes were provided in mashed, fried or in curry form. Eggs were given in boiled form. These foods could not meet the 1/3rd daily nutrient requirement of children due to lack of dairy products, fruits and green leafy vegetables. Therefore Mid-Day Meals provided by schools cannot be said to be nutritionally adequate.

A study on school children to assess their eating pattern during lunch time has shown that majority of children did not meet the recommended targets for lunch time's nutrient intake, especially for micronutrients[1].

Conclusion

Though most of the Mid-Day Meal beneficiaries had normal parameters of height, weight, mid upper arm circumference and body mass index but clinical symptoms were prevalent due to micronutrient deficiencies. No nutrient requirements were met other than that of the protein through Mid-Day Meal. The schools were giving rice, dal, aloo curry, fried aloo, luchi most of the time and egg once a week. These foods could not meet the 1/3rd of the daily nutrient requirement of the children. Thus in order to improve the nutritional

status of the children, green leafy vegetables, fruits and dairy products should be included in the Mid-Day Meal.

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Evaluation of Trace Elements in Commercially Available Canned Foods

Samraggi Saha Choudhury and Vipasha Chakravarty

ABSTRACT:

A survey was conducted to check the availability of different canned foods in various stores of Kolkata. After the survey, two stores were selected from where canned foods were collected and one local market from where corresponding fresh foods were collected. The foods were then prepared for freeze drying and carbonization. After the samples were prepared they were crushed into powder and pellets were prepared by using a pelletizer. Trace element concentrations were determined by EDXRF (Energy Dispersive X-Ray Fluorescence) Spectroscopy technique and the results were analyzed to compare the elemental concentration of canned and fresh samples. The results showed significant variation in trace element concentration among the different types of samples. The data obtained was compared with the standard values of Indian Council of Medical Research (ICMR) and Tolerable Upper Limits.

Keywords: Trace Elements; Freeze Drying; Carbonization; Canned Foods; EDXRF; ICMR.

Introduction

Nutrition is a basic human need and a prerequisite to healthy life as it is the sum total of the processes involved in the taking in and the utilization of food substances by which growth, repair and maintenance of the body are accomplished. In the process of acquiring proper nutrition fruits and vegetables provide exceptional nutritional benefits. Fruits and Vegetables stand as the cornerstone of a healthy diet. Traditionally in India, unprocessed, fresh fruits and vegetables were sold in the local markets by the venders. But the import of technological developments in food processing to India has led to availability of canned foods (fruits and vegetables) in Indian cities. For this little credit also goes to globalization of agricultural marketing.

Canning is a method of preserving food in which the food contents are processed are sealed in a airtight container. The canning process involves placing the food in the jars and heating the jars to a temperature that abolishes micro organisms responsible for health hazards and food spoilage. The heating also destroys the enzymes that may cause undesirable change in the flavor, colour and texture of the foods. Air is driven from the jar during heating. As it cools a partial vacuum is formed. The vacuum seal prevents air from getting back into the products.

There are two safe methods of canning: Water Bath and Pressure Canning. Which one to use depends on the type of food being canned. High acidic foods can be safely processed using a water bath canner. And low acidic foods are safely canned in pressure canner[7].

Canned foods are widely accepted and being used globally. However, health concerns related to trace elemental/heavy metal contamination have been reported.

Trace elements are chemical elements that are present in samples in very low concentration usually in the range of milligrams per kilogram (ppm). Most of the trace elements belong to heavy metal group. Heavy metals are commonly defined as those having a specific density of more than 5 g/cm^3. Heavy metals are natural components of the Earth's crust and cannot be degraded. They enter the human body through food, water and air[2].

Trace elements are also present in human body. Some of these elements are essential for living organisms in very small amounts, and a slight imbalance in their availability may lead to either toxicity or deficiency. Trace element plays an important role in chemical, biological, biochemical, metabolic, catabolic and enzymatic reactions in the living cells of plants, animals and human beings. The role of trace elements in body metabolism is of prime importance. Their deficiency causes diseases, whereas their presence in excess may result in toxicity to human life.

Toxic metals are metals that form poisonous soluble compounds and have no biological role that is they are not essential minerals. Often heavy metals are thought as synonymous, but lighter metals also have toxicity, such as beryllium, and not all heavy metals are particularly toxic, and some are essential, such as iron. The definition may also include trace elements when considered in abnormally high, toxic doses. A difference is that there is no beneficial dose for a toxic metal with no biological role.

Various developments in agriculture and technology can affect the trace element of foods. The use of agricultural chemicals, the introduction of new varies of plants, alterations in feeding practices used for animals and other new techniques designed in increase food production and yields may affect the composition of basic food items. There are three major factors influence the amount of trace elements in foodstuffs as consumed.

1. Inherent characteristic of the plant and animals.
2. Environmental conditions affecting plants and animals.
3. Methods for handling and processing of the plant and animals material.

Food is the major intake source of toxic trace elements by human beings.

Methodology:

Sample collection: After the survey two supermarkets which got finalized were Spencer's (Gariahat) and C3 (City Centre Salt Lake). The reason behind selecting these markets was varieties of canned foods are available here and more or less same types of products are available in these two places. Two companies were finalized Company A which was collected from Spencer's and Company B which was collected from C3. These two companies were selected as the canned food products were common. Five types of canned foods were collected as samples. They were pineapple, sweet corn, baked bean, mushroom and peas. These samples were collected since these are the most commonly consumed by a large number of people. The other reason being, the availability of their fresh products. The fresh products were collected from the local market of Gariahat.

Sample preparation: The food products were cut into very small pieces to increase surface area. They were put into a glass vial and a rubber cork was attached. The vial then dipped in liquid nitrogen and was attached to the freeze drier.

Mushrooms, Peas, Sweet Corns and Baked Beans are dried with the help of freeze drier. Sugar and moisture content of Pineapple is much higher so it cannot be dried into powder in the freeze drier as it was becoming sticky by absorbing moisture. Hence carbonization method has been used to turn it into ash.

Pineapple was cut into pieces and placed into a 150ml porcelain cup, and burnt a slowly on a Hot Plate at a temperature of 150°-200°C. It was carbonized for 30 minutes at 300°C in a Muffle Furnace, and then was allowed to cool in a dessicator for 30 minutes.

Pellet preparation: The carbonized sample is transferred into a Mortar and ground for 10 minutes. 120mg of sample powder and 30mg of the Cellulose are ground in mortar for 5 minutes. Cellulose acts as a binder.

Subsequently after freeze drying dried samples were then ground to powder using Mortar Pestle. For the pellet preparation 150mg of the powdered sample was taken and a high pressure of 120kg/cm^2 was applied in the Pelletizer for 2 mins. A 13mm die was used in the Pelletizer for the pellet preparation. 3 identical pellets were made from each sample.

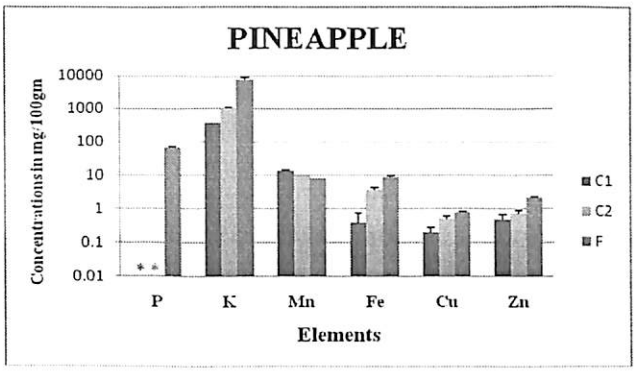
Elemental analysis of the samples by EDXRF: In the present study, the Xenemetrics previously Jordan valley EX3600 EDXRF Spectrometer has been used for elemental analysis. This consists of an X-Ray tube with an Rh anode as asource of X-Rays with a 50V, 1mA power supply, Si (Li) detector with a resolution of 143eV at 5.9keV. 10 sample turrets enable mounting and analyzing 10 samples at a time. The inbuilt software nEXT carries out the quantitative analysis[6].

After the elemental analysis of the samples by EDXRF, the concentration of each element present which was in ppm (mg/kg) was first converted into mg/100gm. Then the samples were compared with the standard elemental concentrations of Indian foods given by Indian Council of Medical Research (ICMR) and RDA (Recommended Dietary Allowances).

Statistical Analysis: Statistical analysis of the data obtained was carried out using EXCEL 2007 data analysis pack. Mean, Standard deviation and ANOVA was calculated for all the data.

Result and Discussion:

The elemental analysis of the canned and fresh food samples carried out by the EDXRF Spectrometer of several elements which were quantified using nEXT software.



*elements not detected

Fig 1: Showing the Concentrations of Elements in Pineapple

Concentration ranges of various elements detected are as follows: P-0 mg/100gm - 72 mg/100gm, K- 345 mg/100gm – 19807 mg/100gm, Mn- 7.9 mg/100gm – 14 mg/100gm, Fe- 0.4 mg/100gm – 9.9 mg/100gm, Cu- 0.2 mg/100gm – 0.9 mg/100gm, Zn- 0.4 mg/100gm – 2.3 mg/100gm, All the elements were found to be in the safety range of consumption as per RDA values.

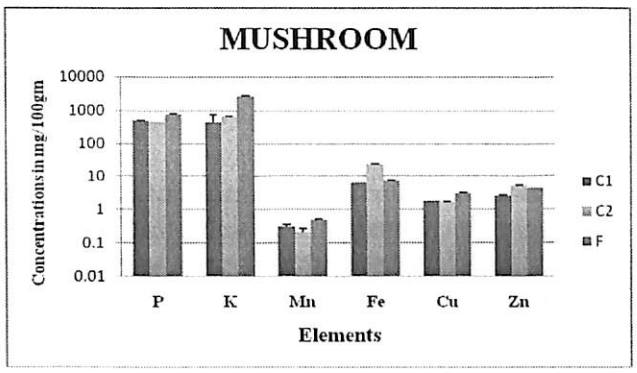


Fig. 2: Showing the Concentrations of Elements in Mushroom

Concentration ranges of various elements detected are as follows: P- 468 mg/100gm – 798 mg/100gm, K- 63 mg/100gm – 2848 mg/100gm, Mn- 0.2 mg/100gm – 0.5 mg/100gm, Fe- 6.3 mg/100gm – 23 mg/100gm, Cu- 1.5 mg/100gm – 3.1 mg/100gm, Zn- 2.4 mg/100gm – 5.4 mg/100gm, All the elements were found to be in the safety range of consumption as per RDA values.

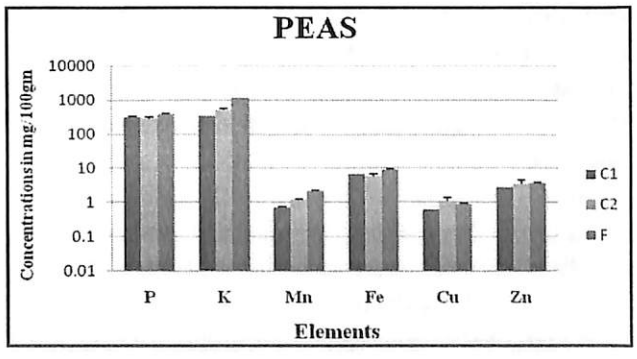


Fig. 3: Showing the Concentrations of Elements in Peas

Concentration ranges of various elements detected are as follows: P- 209 mg/100gm – 384 mg/100gm, K- 315 mg/100gm – 1135 mg/100gm, Mn- 0.6 mg/100gm – 2.8mg/100gm, Fe- 5.9mg/100gm – 9.6mg/100gm, Cu- 0.6 mg/100gm – 1.1mg/100gm, Zn- 2.8mg/100gm – 3.9mg/100gm, All the elements were found to be in the safety range of consumption as per RDA values.

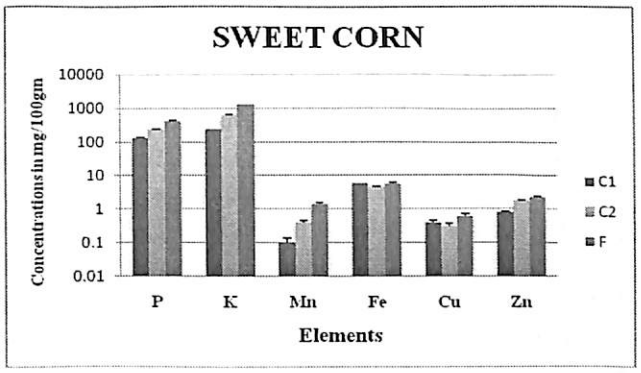


Fig. 4: Showing the concentrations of Elements in Sweet Corn

Concentration ranges of various elements detected are as follows: P-131 mg/100gm – 434 mg/100gm, K- 241 mg/100gm – 1243 mg/100gm, Mn- 0.09 mg/100gm – 1.5 mg/100gm, Fe- 4.2 mg/100gm – 6.3 mg/100gm, Cu- 0.2 mg/100gm – 0.7 mg/100gm, Zn- 0.8 mg/100gm – 2.4 mg/100gm, All the elements were found to be in the safety range of consumption as per RDA values.

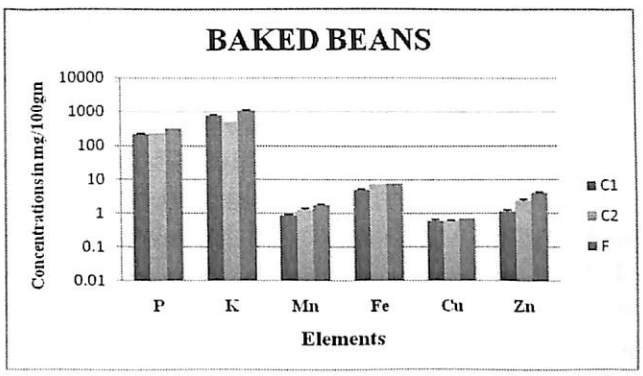


Fig. 5: Showing the Concentrations of Elements in Baked Beans

Concentration ranges of various elements detected are as follows: P-200 mg/100gm – 323 mg/100gm, K- 479 mg/100gm – 1104 mg/100gm, Mn- 0.9 mg/100gm – 1.8 mg/100gm, Fe- 4.9 mg/100gm – 8.1 mg/100gm, Cu- 0.5 mg/100gm – 0.7 mg/100gm, Zn- 1.1 mg/100gm – 4.4 mg/100gm, All the elements were found to be in the safety range of consumption as per RDA values.

Results of ANOVA analysis were done in all the samples to check the statistical significance of variations. The null hypothesis here is that the

group means are all equal, and the alternative hypothesis is that they are not. A big F i.e. the ratio between the variance between the groups and variance within the group, with a small p-value (level of significance), means that the null hypothesis is discredited, and we would assert that the means are significantly different, while a small F, with a big p-value indicates that they are not significantly different. In Pineapples the variations between the groups i.e. between C1, C2 and F are found to be statistically significant at $p<0.05$ for the elements such as P, Mn, Fe, Cu Zn and non-significant for the elements such as K. In Mushroom, Peas the variations between the groups i.e. between C1, C2 and F are found to be statistically significant at $p<0.05$ for all the elements such as P, K, Mn, Fe, Cu Zn. In Sweet Corn, Baked Beans the variations between the groups i.e. between C1, C2 and F are found to be statistically significant at $p<0.05$ for the elements such as P, K, Mn, Fe, Zn and non-significant for the elements such as Cu.

The elements detected have known functions at particular concentration in the human body in terms of physiological processes. Deviation from this concentration may lead to either deficiency or toxicity. The role of each element in human body, deficiency a toxicity syndrome for each elements a probable interference of trace a/or heavy metals present in canned food as possible contaminant, are discussed as follows. Moreover few suggestions to be considered before human consumption of such products are also described.

Phosphorus: Phosphorus is a component of adenosine_triphosphate (ATP), a fundamental energy source in living things. It is found in complex organic compounds in the blood, muscles, a nerves, and in calcium phosphate, the principal material in bones and teeth[4]. High amount of Phosphorus consumption on a regular basis might have a negative impact on the calcium availability. In the present study Phosphorus was below detection limit in pineapples of both companies. In fresh pineapples, mushrooms, peas, sweet corn the value of phosphorus is higher than the ICMR reference value. In baked beans the value is less than the ICMR reference value. Maximum Phosphorus was observed in fresh mushroom which is well within the RDA range. The high phosphate level can be due to the usage of excessive phosphorus based fertilizers and organophosphorus pesticides[1].

Potassium: Potassium is fairly abundant in the body and is an extremely important element for human body. It regulates the osmotic equilibrium of the body fluid, maintains an ionic balance which affects capillary and cell function and also the excitability of nerve and muscles. Hypokalemia is intimately associated with ventricular ectopy (PVCs) and an increased risk of ventricular fibrillation. High blood levels of potassium inhibit platelet aggregation and thus help prevent ischemic stroke and decrease the progression of atherosclerosis. [3] In the present study highest potassium value is present in pineapple. And all the samples have higher value of potassium than ICMR reference value. The possible reason behind high potassium level in the fresh samples can be due to use of high potash fertilizers or increased potassium uptake by the plant during farming.

Manganese: The trace element manganese is essential for normal development and body function across the life span of all mammals. Manganese in small amount is essential to several critical enzymes involved in energy production bone formation and protein, fat metabolism and in the production of cholesterol. It is more frequently of toxicological concern because overexposure to the metal can lead to progressive, permanent, neurodegenerative damage, resulting in syndromes similar to idiopathic Parkinson's disease[3]. In the present study only pineapples have manganese value higher, other samples have values within the range prescribed by ICMR.

Iron: Iron is required for synthesis of hemoglobin. It serves as a carrier of oxygen to the tissues from the lungs by red blood cell hemoglobin. Reduced oxygen transport can increase fatigue and impair immune function through oxidation reduction reaction. Iron is involved in synthesis of DNA and plays a role in immune system. Iron deficiency may cause learning problems in children and in adolescents. [3] In the present study fresh pineapples have higher value of iron but the pineapples from both the companies have value within the reference rage of ICMR. Rest of the samples have higher values of iron than the reference value of ICMR. The high concentration of iron in the samples can also be due to the high load of iron in the atmosphere of Kolkata[7].

Copper: Copper is a trace element, important for the function of many cellular enzymes. Copper plays a pivotal role in cell physiology as a catalytic cofactor in the redox chemistry of enzymes, mitochondrial respiration, iron absorption, free

radical scavenging and elastin cross-linking. Copper deficiency can significantly increase the plasma cholesterol level increasing the risk of cardiovascular disease. Acute symptoms of copper poisoning by ingestion include vomiting, hypertension, coma, jaundice and gastrointestinal distress. Chronic effects of copper exposure can damage the liver and kidneys[3]. In the present study all the samples have copper values within the range of ICMR values. Copper is released into the environment primarily through mining, sewage treatment plants, solid waste disposal, and industrial wastewater[8].

Zinc: Zinc, an essential trace mineral, is required for growth and development, testicular maturation, neurological function, wound healing and immunocompetence. It is essential for cell division and the synthesis of DNA and protein. These enzymes are involved with the metabolism of protein, carbohydrate, fat and alcohol. Symptoms of acute zinc toxicity include nausea, vomiting, epigastric pain, abdominal cramps and diarrhoea[3]. In the present study zinc values are higher in pineapples than the ICMR values. But other samples have value within the range of ICMR values.

In the present study the elemental content of fresh samples are more in comparison to canned foods with few exceptions as discussed below. Phosphorus and potassium in all the samples follows the similar trend i.e. the values are less than the fresh. Magnesium, iron, copper, zinc also follows the similar trend; all the values are less than the fresh, except magnesium value in pineapple, iron and zinc values in mushroom in Company 2, iron in sweet corn in Company 1. Such variations in the elemental content may be attributed to faulty agricultural practices such as over manuring, waste water irrigation, contamination during food processing, and or refinement of fresh samples before being packaged into cans. When high concentrations of NPK fertilizers are used, then there is a possibility of elemental uptake, mobilization and further sequestration in edible and vegetative parts of plants. Pesticides also contain both essential and toxic heavy metals and application of such pesticide may result in contamination of vegetables. Soil type, the rootstock used for fruit trends, mulching, irrigation, fertilization a other cultural practices influence the water a nutrient supply to the plants, which can affect the composition a quality attributes (appearance, texture, taste a aroma) of the harvested plant parts. Trace metals may enter the human body through consumption of edible plant parts grown in contaminated soil[7]. The canned samples generally, recorded lower concentration of heavy metals as compared with the fresh food samples and could be considered safer for consumption. This is because canned food undergoes processing at several levels which helps to lower the presence of heavy metals. Different stages of processing and preservation helps to eliminate the high concentration which is found in fresh samples[8]. Canning requires various stages of processing which include washing, heating and soaking in brine solution of the food samples. Due to these processing steps concentration of the trace elements is reduced than the fresh foods.

Conclusion:

This study has estimated the elemental content (essential and toxic) in different canned food categories and brands sold in Kolkata market. Results obtained in the present study demonstrate variation in the elemental content in fresh foods with respect to that of ICMR reference values. And these variations may be attributed to the soil characteristic, faulty agricultural practices such as waste water irrigation and over-application of pesticides and, fertilizers. The elemental content of processed and canned foods has shown variation (either increase or decrease) in most of the elements with respect to that of fresh food. The analysis of variance (ANOVA) indicated statistical significant differences in most of the elements in the five canned food categories. The decrease in concentration of important nutrient elements like K, Mn, Fe, Cu and Zn may also be attributed to the food processing techniques. The effect of such variation in the elemental content between the fresh and canned food, on human health after the consumption is yet to be studied. There is lack of report about the suitability of both product (caned/fresh) for human consumption with respect to the elemental concentration and bio-availability of the individual element after consumption and needs attention from scientific researchers. This aspect needs urgent attention from scientific researchers.

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An Association Between the Nutritional Status, Food Habits and Physical Activity Level in School Children belonging to High Income Group

Riddhi Jain and Annalakshmi Chatterjee

ABSTRACT

A survey was conducted among adolescent boys and girls aged 13-15 years and belonging to high income group of society to assess their nutritional status, their nutrient intake, their daily average intake of different food groups and their weekly physical activity level. A structured questionnaire was used to obtain and record the results. The body mass index, food consumption and physical activity level was determined. The data was analyzed according to gender and nutritional status. The prevalence of obesity was found to be higher among boys. Daily intake of sweets and snacks as well as dairy products was higher among boys while the girls consumed a higher proportion of vegetables. Physical inactivity was much higher in girls while the boys were quite active during and after school hours. Food intake did not seem to have much effect on the nutritional status of the subjects, presuming that food intake greater than the recommended daily allowance causes positive energy balance leading to increase in body mass index. No significant association was seen between nutritional status and level of physical activity among both genders.

Keywords: Body Mass Index (BMI), School Children, Nutritional Status, Food Habits, Food Consumption, Physical Activity.

Introduction

Adolescence is a time of rapid growth and transition from childhood to adulthood, from dependence to independent living in many societies. This period of life is often neglected by nutritionists, yet growth and development have a significant impact on health as adults. In particular, adolescent girls are often at nutritional risk.

Studies on growth and physical development of the children are important as they provide determinants of a nation's health. Growth studies have an important place in the study of individual differences in form and shape. Appraisal of the progress of a country in the field of health can be made from time to time with the help of such studies[9].

Adolescence is a significant period in the development of dietary habits in children that remain at least in part as the individual progresses into adulthood [1]. Although many adolescents demonstrate awareness and knowledge of nutrition and healthy eating, it does appear they find it difficult putting this theory into practice[3, 20].

Adolescent food habits and physical activity patterns are an important concern in the present accelerated nutrition transition. Cross-sectional studies have documented the relationship between physical activity, physical fitness and health, and a number of cardiovascular risk factors during childhood and adolescence[13, 23]. Similarly, longitudinal studies have shown that the degree of physical fitness during childhood and adolescence may determine one's physical fitness as an adult. The detailed relationship between physical activity, fitness, food choices and nutritional status in adolescence remains to be clarified. There is a need to understand the relationship between nutritional status and eating habits and physical activity levels of adolescents from privileged populations especially from developing countries.

Hence, the present study was planned to investigate how dietary habits and physical activity affect the nutritional status of girls and boys from high income group residing in Kolkata, West Bengal.

Methodology

This was a cross-sectional study which included variables like nutritional status, food habits and consumption and physical activity.

Sample

The subjects were selected from three schools in Kolkata, (West Bengal). All three schools are high income schools. Here, the children come from families where their parents are educated and know the importance of good nutrition and have knowledge about healthy eating habits. Introductory letters were given to concerned schools seeking permission to carry out the dietary survey. A total of 150 children were selected from three different schools. Out of this 75 girls and 75 boys were selected. The age of the children ranged from 13-15 years. No special emphasis or preference was given to any individual community while carrying out the survey.

Nutritional Status

The height of the subject was measured using a standard anthropometer. With the arm of the anthropometer firmly touching the scalp, the vertical distance from the standing surface to the top of the head was measured. The weight of the subject was measured without shoes and in school uniform using a portable human weighing machine with an accuracy of 0.5 kg. Body Mass Index (BMI) was calculated for each child (using the formula: weight in kg/height in m^2) and BMI percentile was determined using 2007 WHO BMI for age gender-specific reference charts[2]. The children were classified as follows according to the Centers for Disease Control BMI-for-age growth charts (2000)[15].

Table 1.1.BMI Categories for children aged 5-18 years

BMI <5th percentile	Underweight
BMI 5th-84th percentile	Healthy weight
BMI 85th-94th percentile	Overweight
BMI ≥ 95th percentile	Obese
BMI ≥ 99th percentile	Severe obese

Dietary Recall

The three day dietary recall is a widely used method of dietary assessment. In this method, the child was asked to recall in as much details as possible, the food intake for three consecutive days at each meal and in between meals. Here the children were shown the standardized glasses, cups, spoons, katoris and different sized chapattis from which they could select the one similar to the amount they had consumed. From this we know the raw amount of the ingredients for which the nutrients can be calculated using food composition tables given by ICMR[6]. Macronutrients protein, fat, carbohydrate and energy and micronutrients like calcium and iron were calculated with the help of Microsoft Excel Spreadsheet using the food composition tables, to check whether they met the daily recommended allowances as stated by ICMR[6].

Food Habits

The food frequency questionnaire was used which helped to ascertain the average frequency of consumption of different food items and the usual portion size consumed by the respondents. The responses in the questionnaire were entered in the form of integer amounts by the respondents. For items that were available only seasonally, such as certain fruits and vegetables, the frequency of consumption was recorded only for the season in which it is consumed.The daily average consumption of different food groups of both genders was determined and represented as amount of consumption in grams per day and compared with a standard set of dietary guidelines[24].

Knowledge And Attitude Towards Nutrition

Each child's knowledge about nutrients and healthy food and their attitude towards the consumption of nutritious food was determined using his questionnaire. It was developed keeping in mind the age and level of education of the subjects. This questionnaire was administered on the subjects in the initial phase of the study to determine if they were capable enough and whether they possessed sufficient knowledge to proceed with the study.

Physical Activity Level

The Physical Activity Questionnaire – Adolescent (PAQ-A)[10] was used which is a self-administered questionnaire. It contained nine questions with multiple choice answers. The children had to select whichever option applied to their own lifestyle and pattern of physical activity. Each choice was given a score and the answers given by the children determined their overall score.Physical activity level of the adolescents obtained by a standard scoring technique[10] was represented in the form of tables and charts.

Statistical tools like t-test and chi-square test were used to determine the association between the nutritional status, food habits and level of physical activity of the subjects.

Results and Discussion

The present study aimed to assess and compare the nutritional status, nutrient intake, food habits and physical activity level of adolescent boys and girls belonging to high income group. The results of the study along with its corresponding observations are presented here.

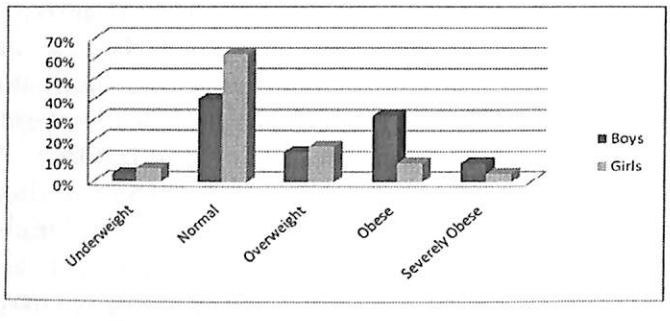


Fig 1.1: Nutritional status of the subjects

It was seen that in both genders, significant difference is found with a shift to overweight and obese among the boys. The prevalence of obesity was significantly higher in boys among their own group (56%) and even when analyzed among the whole sample (28%). The girls exhibited a higher prevalence towards normal weight (62%) and underweight (6.6%) compared to the boys (40% and 4% respectively). With nearly half of the subjects falling in the overweight to severely obese category, these results are discouraging as it has been found that rates of cardiovascular disease and diabetes increase in both men and women who were obese during adolescence[4], and approximately 50% of obese adolescents with a BMI at or above the 95th percentile become obese adults[4].

Knowledge and attitude towards nutrition

Since the study deals with school children, we were eager to know whether they had a basic understanding of nutrition, so, the level of knowledge of the subjects towards nutrition was assessed using a questionnaire. It was observed that most of the subjects had a fairly good knowledge about carbohydrates, vitamins and fats, but, surprisingly only 10.6% of the subjects had some knowledge about proteins. Several studies have shown that although many adolescents demonstrate awareness and knowledge of nutrition and healthy eating, it appears they find it difficult putting this theory into practice[1, 3, 20].

The attitude of the subjects towards nutrition was assessed and it was found that though most of the subjects (48%) responded that they prefer home cooked food over restaurant prepared food, it was seen that these children also had high consumption of sweets and snacks. 33% of the subjects considered healthy eating as just another fashion or trend, while 26.6% of the subjects were not willing to reduce consumption of unhealthy foods.

Table 1.2: Mean nutrient intake of the subjects

Nutrient	Gender	RDA Value g/day	Mean Intake g/day	Difference (RDA-Mean)
Protein	Girls n=75	52	51	1
	Boys n=75	54.3	53	1.3
Fat	Girls n=75	40	46	-6
	Boys n=75	45	50.5	-5.5
Carbohydrate	Girls n=75	408	230	178
	Boys n=75	481	277	204
Energy	Girls n=75	2330	1546	784
	Boys n=75	2750	1916	834
Iron	Girls n=75	27	11	16
	Boys n=75	32	13	19
Calcium	Girls n=75	800	597	203
	Boys n=75	800	763	37

From the above table we can see that both boys and girls met their RDA of protein. The fat intake for both groups was significantly higher than their RDA. As for carbohydrate, energy and iron, the intake of both groups was much lower than their RDA. While the girls did not meet the RDA for calcium, no significant difference was found between the mean intake and RDA of calcium for boys.

One of the objectives of the study was to assess the nutrient intake of the subjects. This was done using t-test for which appropriate hypothesis was laid down. Based on these hypotheses the following observations have been made from the data.

In case of protein, no significant difference was seen in the mean intake for both groups when compared to their RDA.From the data provided by the dietary recall it was seen that the protein requirement was met mostly by consumption of paneer and cheese by vegetarians, and the consumption of fish by non-vegetarians.

Significant difference was seen in the intake of fat by both groups. Consumption of fat was found to be 115% of the RDA in case of girls and 112% of the RDA in case of boys. Such high intake of fat may be a result of easy accessibility of fast-food and junk food like chips, cakes, biscuits and beverages. A study showed that the main sources of total and saturated fat are confectionary, cakes and biscuits in case of children[19].

Carbohydrate and energy intake was significantly lower than the RDA for both groups. Most of the subjects tended to skip meals and replace it with junk food like french fries, chocolates, soda drinks and street food.

Both girls and boys consumed only 40% of their RDA for iron. This could be due to low consumption of green leafy vegetables and red meat (refer Fig. 1.2).

Interestingly, only 74% of the RDA for calcium was met by the girls while 95% of the RDA for calcium was met by the boys. Research suggests that adolescents, particularly girls, may avoid dairy products due to concerns that these foods are "fattening". However, avoidance of dairy foods due to possible association with relative body weight is not supported by the available results[14].

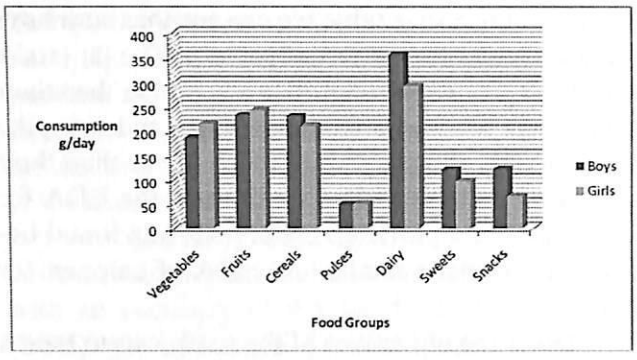


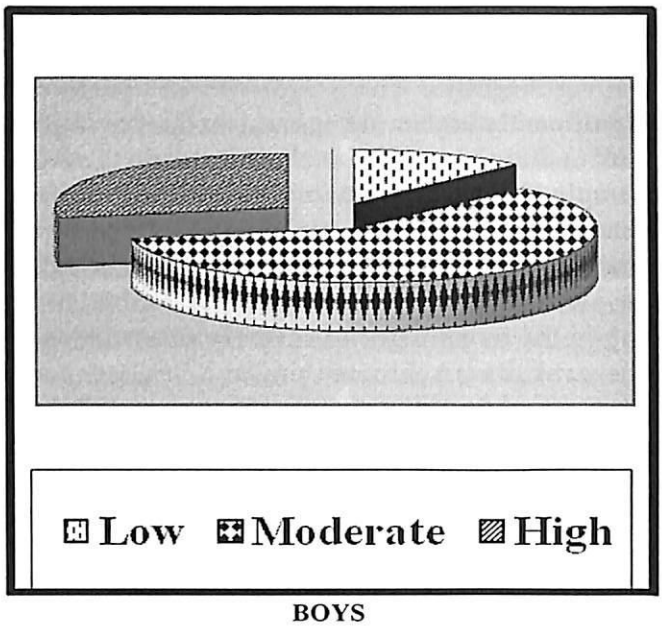
Fig 1.2: Daily average intakes of major food groups.

The data in fig.1.2 represents the average daily food intake of the total sample, expressed in grams per day, by gender group. The intake of **vegetables** was moderate; the amount consumed was equivalent to approximately 1.8-2 servings/day. This amount is slightly lower than the recommendation for adolescents indicated by the Dietary Guidelines for Indians by National Institute of Nutrition, Hyderabad[24], which is 3 servings/day. The intake of fruits on the other hand was around 2.2 to 2.4 servings/day which is more than double the amount recommended for adolescents, which is 1 serving/day. The intake of pulses and legumes by both genders almost met the recommendations.

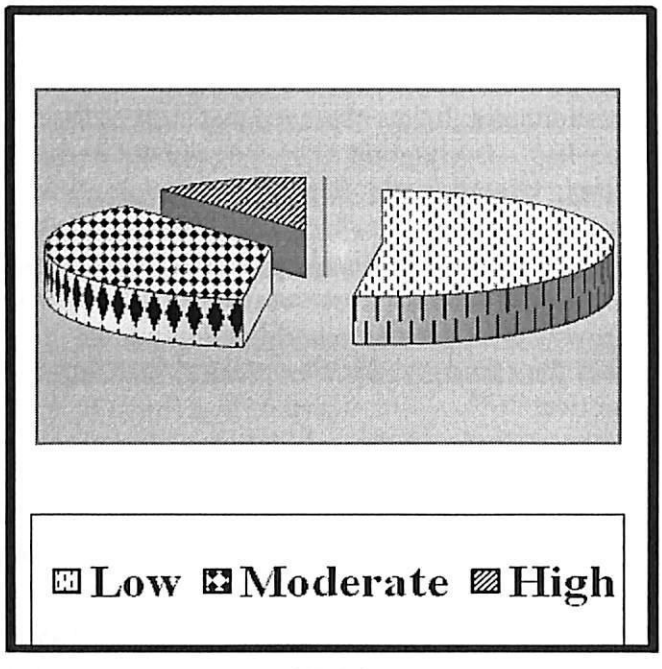
The greatest difference between daily average intake and recommended amount was present in the cereals group. Boys consumed nearly half the recommended amount of 14 servings/day. Similarly the girls consumed only 2/3rd of the recommended serving of 11 servings/day of cereals. Adolescent males and females both need to consume around 5 servings/day of milk and milk products. While the boys consumed 3.5 servings/day on an average, the girls consumed 2.9-3 servings/day. Intake of **dairy products** is seen to be low for both genders. These results have been found to be consistent with other studies done in the country and elsewhere[16, 18].

Intake of dairy products, sweets and snacks was found to be higher among the boys while consumption of vegetables and fruits was somewhat higher among girls. Not much difference was seen in the consumption of pulses among both groups.

Consumption of energy-dense foods like sweets and snacks during youth has both immediate and long-term health consequences, including higher body mass index[12]. On the other hand, diets rich in fruits and vegetables have important health-protective effects including protection against the development of certain cancers at puberty and in adulthood[17].



BOYS



GIRLS

Fig. 1.3: Physical activity level of the subjects

The data in fig.1.3 represents the physical activity level of the subjects. The most striking feature of this data is that there was a high prevalence of low physical activity levels among girls (52%) as compared to boys (12%). The boys showed significantly higher levels of physical activity as compared to the girls. Boys have consistently been found to be more active than girls[16].

Longitudinal studies have shown that the degree of physical fitness during childhood and adolescence may determine one's physical fitness as an adult. In addition, poor physical fitness during these stages of life seems to be associated with later cardiovascular risk factors such as hyperlipidemia, hypertension and obesity[11]. It should be remem-

bered, however, that this is a cross-sectional study and thus determining that low physical activity is the cause for the development of obesity is difficult. Estimates obtained from questionnaires are useful in relative terms and can serve to rank individuals in a population from the most active to the least active[16].

Table 1.3 Association between nutritional status and food intake (N=150)

Category	Underweight		Normal		Overweight		Obese		Severely Obese	
	Girls n=75	Boys n=75	Girls n=75	Boys n=75	Girls n=75	Boys n=75	Girls n=75	Boys n=75	Girls n=75	Boys n=75
No. of subjects	5	3	47	30	13	11	7	24	3	7
Mean Protein Intake g/d	57	41	50	57	54	50	47	53	45	50
Mean Fat Intake g/d	53.5	30	43	49.5	52	46	48	54	48	58
Mean CHO Intake g/d	256	230	230	280	235	272	215	282	206	273
Mean Energy Intake g/d	1769	1368	1518	1907	1629	1937	1477	1996	1448	1886
Mean Iron Intake g/d	9	14	12	14	9.5	12	9	13	9	12
Mean Calcium Intake g/d	460	447	596	813	552	739	726	767	729	704

The above table shows the nutritional status and corresponding mean food intake of the subjects according to gender. An overall increase in mean fat, carbohydrate and energy intake is seen in boys with increasing body fat content. In girls, a negative association is seen between mean fat, carbohydrate and energy intake and body fat. Protein intake is seen to increase with increasing adiposity among boys, but this increase is only marginal. A marginal decrease in protein intake with increasing adiposity is seen among girls. While a positive association is seen between food intake and body fat among boys, this association seems to be negative in case of girls. Dietary reporting errors are common in dietary studies[7, 22], especially among individuals who are overweight or obese[5].

Not much difference was seen in mean iron intake with increase in body fat, in case of both genders. Highest intake of iron was among normal weight adolescents for both groups. Since the main source of iron in the Indian diet is in the form of green leafy vegetables and fruits, this evidence reinforces the importance of fruit and vegetable consumption for a balanced diet. Mean calcium intake increased with increase in body fat.

Table 1.4: Association between nutritional status and physical activity.

Gender	Nutritional Status	Physical activity			Estimated value of chi-square statistic	Critical value at 5% level of significance
		Low	Moderate	High		
Girls	Underweight	2	3	0	$x^2=6.65$	17.5
	Normal	24	17	6		
	Overweight	8	5	0		
	Obese	3	2	2		
	Severely obese	1	2	0		
Boys	Underweight	0	1	2	$x^2=8.87$	
	Normal	4	16	10		
	Overweight	1	5	5		
	Obese	3	17	4		
	Severely obese	1	6	0		

The data in Table 1.4 represents the association between the nutritional status and level of physical activity of the subjects. For fulfilling the main objective of the present study, Chi-square test was used. As per the data collected from the given sample, it is found that there exists no significant association between the nutritional status and the level of physical activity of the subjects.

From the data, a higher prevalence of low level of physical activity is seen among the girls as compared to the boys, and, among both groups, none of the severely obese was engaged in high level of physical activity. However, these results were not statistically significant.

Some studies indicate a lack of physical activity among overweight and obese children[8], while other studies reveal that nutritional status was not associated with physical activity[21] since no significant difference was seen in the level of physical activity between obese and non-obese subjects.

Summary and Conclusion

From the study it was found that the nutritional status of both genders differed markedly with a shift towards overweight and obesity among boys. 56% of the boys fell in the overweight to severely obese category and 30.6% of the girls belonged to that category. The girls exhibited a higher prevalence towards normal weight (62%) and underweight (6.6%) compared to the boys (40% and 4% respectively). Knowledge of proteins was low among the subjects and most of the subjects (48%) preferred home cooked food over restaurant cooked food. Both the gender groups met the RDA of protein. Mean intake of fat was higher than the RDA in case of both genders. Carbohydrate intake, total energy and iron intake was much lower than the RDA for both genders. While the girls did not meet

the RDA for calcium, no significant difference was found between the mean intake and RDA of calcium among the boys. Intake of fruits was found to be more than double the amount recommended for adolescents, while intake of vegetables was less. Intake of cereals was very low, nearly half to 2/3rd of the recommended amount. Intake of milk and dairy products was low in case of girls but moderate in case of boys. Consumption of sweets and snacks was higher among the boys as compared to the girls. Prevalence of low level of physical activity was higher in the girls. 89% of the girls were engaged in low to moderate physical activity in the week preceding the day of the study, while 88% of the boys were involved in high to moderate level of activity. An overall increase in mean fat, carbohydrate and energy intake was seen in boys with increasing BMI. In girls, a negative association was seen between mean fat, carbohydrate and energy intake and BMI. No significant association was found between nutritional status and physical activity level of the subjects.

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Study on the Incidence of Malnutrition in Children (1-5 Years) of Low Income Group

Mayuri Sen and Ms. Damanjeet Kaur

ABSTRACT

In the present study an attempt has been made to assess the grades of malnutrition in the children with the help of anthropometric measurements, visible clinical features and a 3-day dietary recall. A sample of 160 children between the age group of 1-5 years belonging to the low income group was selected along with their mothers. The probable causes of malnutrition were also taken into account through the mother's BMI, awareness, knowledge and practices using a questionnaire. It was seen that 53.7% of the children were underweight, 34.3% were wasted and 77.8% were stunted and showed distinct clinical symptoms of malnutrition. Role of mothers' nutritional status during pregnancy, breast feeding, weaning and dietary practices, knowledge of proper health care, sanitation and hygiene could be the probable causes leading to malnutrition in children apart from other factors that were directly related to malnutrition.

Keywords: Malnutrition, Wasting, Stunting, Underweight, Micronutrient Deficiency, Overnutrition, Marasmus, Kwashiorkor, Marasmic Kwashiorkor, Breast Feeding, Weaning.

Introduction

Malnutrition refers to any imbalance in satisfying nutrition requirements. Malnutrition among children is often caused by the synergistic effects of inadequate or improper food intake, repeated episodes of parasitic or other childhood diseases such as diarrhoea and improper care during illness. [8]

Malnutrition can take a number of forms – stunting, wasting and micronutrient deficiency, obesity – which are described below[10].

1.1 Types Of Malnutrition

Malnutrition is of various types which can be broadly classified as Acute Malnutrition and Chronic Malnutrition[11].

1.1.1 Acute Malnutrition

The first form of growth failure is acute malnutrition. There are 3 clinical forms of acute malnutrition like Marasmus, Kwashiorkor and Marasmic-kwashiorkor.

- Marasmus: A rapid deterioration in nutritional status in a short time can lead to marasmus. It is characterised by severe wasting of fat and muscle which the body breaks down to make energy[11].

Wasting: Wasting results from a severe and often sudden lack of food or disease, as a result the body begins to digest muscle to meet the need for protein, minerals and energy[11].

- Kwashiorkor or bi-lateral oedema: Kwashiorkor is characterised by bilateral pitting oedema (affecting both sides of the body) in the lower legs and feet which as it progresses becomes more generalised to the arms, hands and face[11].
- Marasmic kwashiorkor or combined wasting and bilateral pitting oedema: Marasmic-kwashiorkor is a combination of both marasmus and kwashiorkor and is characterized by the presence of both wasting and bilateral pitting oedema[11].

1.1.2 Chronic Malnutrition

Chronic malnutrition or stunting is long term growth failure. A child who is stunted or chronically malnourished often appears to be normally proportioned but is actually shorter than normal for his/her age[11].

Stunting: Stunting, or chronic malnutrition, is a result of a child having a poor diet, too few calories or too little nutritious food, or both – for a number of years, or an infection leading to malabsorption of nutrients. The first 1,000 days of life beginning with conception, through a mother's pregnancy and up until the age of two is the most critical period in a child's development. Forty eight per cent (i.e. 61 million children) of Indian children under five years are stunted due to chronic undernutrition[10].

1.1.3 Micronutrient Deficiency

Micronutrient deficiencies account for one-third of all malnutrition-related child deaths, and 10% of all children's deaths. Nearly all deaths linked to micronutrient deficiency are due to a lack of vitamin A, zinc or iron[10].

Vitamin A deficiency affects preschool-aged children (under 5 years), school age children and pregnant women. Vitamin A deficiency causes xerophthalmia, impairs the immune system and increases the severity and mortality risk of measles

and diarrhoeal disease[63]. Iron deficiency affects 3.5 billion people worldwide. The most affected groups are pregnant women, preschool-aged children (under 5 years), 5-14 year old children and older adults. Lack of iron eventually results in iron-deficiency anaemia. Vitamin C (also called Ascorbic Acid) deficiency leads to Scurvy[11].

1.1.4 Overnutrition

At the same time as a large number of population suffers from under nutrition, more than 100 million people (11% of Indian population) in India are over-nourished. Overnutrition can be defined as consuming either too much calories or the wrong types of calories such as saturated fat, trans fat or highly refined sugar which leads to obesity and many other chronic diseases like diabetes mellitus.

1.2 Causes

Malnutrition is an underlying cause of more than 2.6 million child deaths every year, a third of the total of child deaths[11]. The various causes of malnutrition are gender inequality, lack of mothers' awareness and knowledge, maternal nutritional status, breast feeding practices, diseases and infections suffered by the children, environmental causes, dietary practices, poverty and food prices and agricultural productivity.

Methodology

A total of 160 children of the age group 1-5 years belonging to the low income group were selected from Jnandeep Valika Vidyalaya and Rajabazar slum area. A structured questionnaire was prepared which was divided broadly into two parts: one for the mother and the other for the child. Information about the child included personal details, anthropometric measurements, clinical information and eating pattern of the child. Information of the mothers included the mother's anthropometric measurements, their education, knowledge, attitude and practices.

To carry out the dietary assessment, the most common low cost recipes were standardized in terms of measuring cups, glasses and spoons in the food laboratory of J. D. Birla Institute.

A three day dietary recall of the subjects was done and ICMR table was used to calculate the average amount of macro and micro nutrients consumed by them.

The data was tabulated and organized and the nutrient adequacy was then compared with the RDA given by NIN, Hyderabad. After obtaining the mean values, the standard deviation was calculated for all the macronutrients and micronutrients.

The degree and type of malnutrition among the children of the low income group were determined and classified by calculating the height for age and weight for age and comparing with the references. Percentages were calculated for analysis of the clinical assessment of the children. The results were represented in the form of tables, pie charts and bar graphs. Statistical analysis was done by using t- tests to accept or reject the formed hypothesis.

Results and Discussion

The data that was collected has been analysed and discussed in this chapter.

Table 1: Mean macro and micro nutrient intake of the respondents of the age group 1-3 years and 4-5 years

Nutrients	Age group (years)	RDA	Mean	Difference between RDA and Mean intake	% of difference between RDA and Mean intake	SE	Value of computed t-test statistic
Protein	1-3	16.7	13.33	3.37	20.18	5.97	3.09
(g/day)	4-5	20.1	17.2	2.9	14.43	4.45	2.76
Fat	1-3	27	19.47	7.53	27.89	5.24	7.87
(g/day)	4-5	25	17.41	7.59	30.36	2.95	10.92
Carbohydrate	1-3	185.5	74.1	111.4	60.05	24.64	24.76
(g/day)	4-5	236.25	108.89	127.36	53.91	25.71	21.02
Energy	1-3	1060	541.92	518.08	48.87	136.79	20.75
(Kcal/day)	4-5	1350	686.98	663.02	49.11	125.35	22.44
Iron	1-3	9	2.53	6.47	71.89	2.01	17.63
(mg/day)	4-5	13	4.85	8.15	62.69	2.12	16.31
Calcium	1-3	600	204.94	395.06	65.84	70.58	30.66
(mg/day)	4-5		212.56	387.44	64.57	123.26	13.34
Vitamin C	1-3	40	16.98	23.02	57.55	7.62	16.55
(mg/day)	4-5		31.73	8.27	20.68	34.05	1.03

It was seen that there was a difference of 60.05% of carbohydrates intake among children of 1-3 years age group while a difference of 53.91% in case of respondents in the age group of 4-5 years. Similarly consumption of protein, fat and energy was found to be below the RDA among the children of both the age groups. There was a huge gap between the recommended allowance and the actual intake of dietary iron and calcium among the children of both the age groups. Similarly there was a difference in Vitamin C intake among the children of 1-3 years of age. The difference was noticeably less (20.68%) among the children of 4-5 years.

All the estimated t-statistics are greater compared to the tabulated t-value (5% level of confidence and 160 samples) therefore there exists a significant difference between the average intake and RDA, except in the case of vitamin C among children of 4-5 years.

In a study of dietary intake and nutritional status of under five children in slums of Kolkata city, it was found that calorie intake of more than 81% of under-five pre-school children was below 50%

of RDA and protein consumption was less than 70% of RDA in about 68% of study population. In case of iron more than 80% of study population was consuming less than 50% of RDA[5].

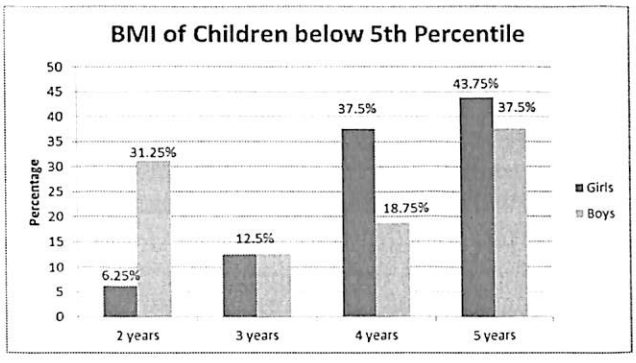

Fig 1: Bar graph showing malnutrition in girls and boys of 2-5 years of age according to BMI.

Figure 1 reveals the percentage of malnutrition in children of 2-5 years of age according to the BMI which has been compared with the reference given by CDC. About 6.2% of the girls and 31% of the boys of 2 years of age were below 5th percentile whereas the percentage of malnutrition in the girls and boys equals in the 3rd year of life (12.5 %). On the other hand, it can be seen that the percentage of malnutrition on girls exceeded to that of boys from 4 to 5 years of age which can be due to the prevalence of gender biasness in the families.

A survey found that Indian mothers selectively feed male children better than female children. More female children suffered from protein energy malnutrition, especially those with mothers in traditional communities[4].

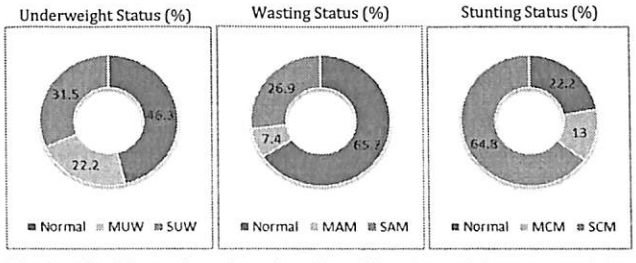

Fig 2: Pie Chart showing the classification of the respondents (1-5years of age) based on the grades of malnutrition.

From the pie chart above the percentage of the children who were underweight and those who were suffering from acute and chronic malnutrition i.e. wasted and stunted respectively can be clearly determined. Among the underweight children, 31.5% were severely underweight (SUW) while 22.2% were moderately underweight (MUW). It was also seen that 26.9% of the children were suffering from severe acute malnutrition (SAM) or wasting and 7.4% were suffering from moderate acute malnutrition (MAM). Moreover there were 64.8% cases of severe chronic malnutrition and 13% cases of moderate chronic malnutrition.

A comparison of male and female children in Amritsar indicates that only 11.23% of girls and 7.39% of boys were normal. On the whole, about 90.80% children suffered from various grades of under nutrition[12].

Table 2: Prevalence percentage of clinical signs and symptoms among children of 1-5 years of age.

PARTS	FEATURES	PERCENTAGES (%)
Nails	Pigmented	36
	Brittle	22
	Soft	35
	Normal	7
Hair	Dry	50
	Rough	21
	Discoloured	5
	Thin	18
	Normal	6
Skin	Dry	88
	Loose	6
	Normal	6
Limbs	Thin	23
	Swollen	42
	Normal	35
Abdomen	Distended	28
	Normal	72
Face	Puffy	39
	Normal	61

From Table 2 it can be seen that 36% of the children had pigmented nails, 18% had thin and 5% had discoloured hair. It was also observed that 88% had dry skin, 42% had swollen limbs, 28% had distended abdomen and 39% had puffy face, which collectively denotes that these children were probably suffering from Kwashiorkor whereas 35% of the children had soft nails, 50% had dry and 21% had rough hair, 6% had loose skin and 55% had thin limbs which can be the probable symptoms of Marasmus.

Similar results were seen in a study conducted in South India, where hair changes like sparseness and depigmentation of the hair, especially at the tips, were observed[9].

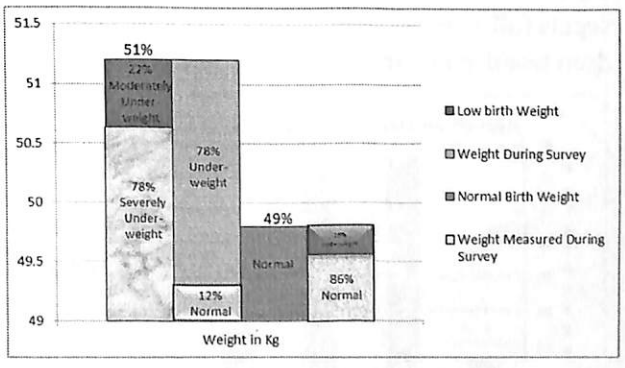

Fig 3: Bar graph showing the child's birth weight and the weight measured during the survey.

The above bar graph shows the birth weight of the children. It was seen that about 51% of the children had low birth weight of which 78% were severely underweight and the remaining 22% were moderately underweight during birth. Of these 51% low birth weight children, only 12% were able to attain normal weight as assessed during the survey. On the other hand, among the 49% of the children who had normal birth weight, 16% were found to be underweight during the survey. Of these 16% underweight children, 25% were severely underweight and 27% were moderately underweight during the survey although they were born as healthy individuals.

A multicentric study done by ICMR in three urban slums of Delhi, Calcutta and Madras revealed that 41.4% live births were LBW as compared to 38.1% rural children. The reasons for this deterioration in weight would be inadequate diet consumed by the child, frequent bouts of infection and diarrhoea. This in turn is due to unhygienic conditions of living[2].

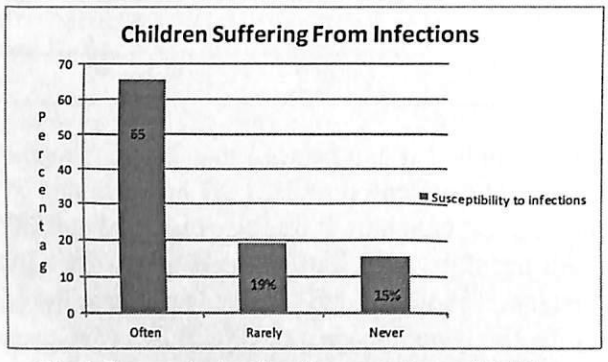

Fig 4: Bar graph showing the percentage of children suffering from infections.

Figure 4 shows the percentage of children suffering from infection in the form of diarrhoea, fever, cold and cough. It can be seen from the figure above that 65% of the children often suffered from infections.

A similar pattern of deaths was seen in Delhi where the major causes of death for infants beyond the neonatal period were diarrhoea, meningitis and sepsis followed by pneumonia[12] among slum children besides nutritional deficiencies[2].

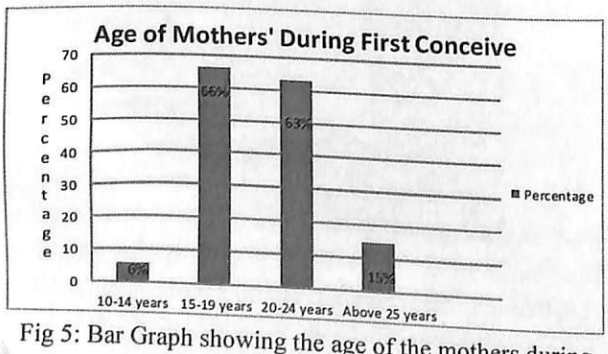

Fig 5: Bar Graph showing the age of the mothers during the first pregnancy

From Figure 5, we can see that about 66% of the mothers in the slums of Kolkata were between the ages of 15-19 years during their first pregnancy while about 6% conceived at 10-14 years of age. At this young age the body of a girl is not well developed which may affect the health and birth weight of the neonate.

A study done in the urban slums of Patiala showed the chances of being underweight decreased as the mother's age increased. Prevalence of underweight children was 75% where mother's age was less than 20 years, whereas it was 39.9%, 32.6% and 32.2% for the age groups 21-25 years, 26-30 years and more than 30 years[6].

Table 3: Awareness and practice of colostrum feeding and lactation among the mothers.

Initiation of Breast Feeding After Birth	Feeding of colostrum	Span of Exclusive Breast Feeding
Within 1 hour : 42%	Fed: 61%	Less than 6 months: 28%
Within 23 hours: 41%	Discarded: 39%	Less than 1 year: 20%
After 24 hours: 27%		More than 1 year: 52%

The above table shows that 42% of the mothers started to feed their child within one hour after birth. On the other hand, 41% and 27% started feeding within 23 hours and next day after the child was born, respectively.

Researches done in Varanasi show that the first feeding was offered mostly within the first 6-8 hours of birth in the urban slum areas and within the first 4-6 hours of birth in rural areas. The majority of children in all groups were breastfed on the 3rd day after birth[2].

From table 3 it is also revealed that in 61% of the cases colostrum was fed.

A research in Andhra Pradesh reveals that breastfeeding was delayed till 3 days in the belief that colostrum is dirty and inadequate to meet the infant's need[3].

Table 3 also shows the time span for which the children of 1-5 years of age were exclusively breast fed. It can be seen that 52% of the children were breast fed for more than a year.

A similar study in Varanasi showed that 53.85% of urban children were breastfed up to 6 months, as compared to 10.21% of those in urban slums or 12.2% in rural areas; breast feeding was prolonged in the slums and in rural areas, and sometimes beyond 2 years of age in rural areas[2].

Researches have shown that prolonged exclusive breast feeding leads to deterioration of the nutrient content of the breast milk and delayed initiation of weaning results in deficiency of nutrients which leads to malnutrition and other childhood diseases[1].

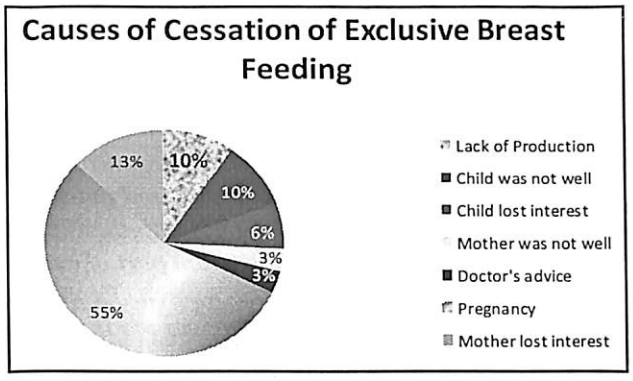

Fig 6: Pie chart showing the various reasons of cessation of exclusive breast feeding to the children

The above chart shows the causes of cessation of exclusive breast feeding. In majority of the cases (55%) another pregnancy of the mother was the main cause followed by losing interest in feeding the child (13%), lack of milk production (10%), health of the child (10%), child lost interest (6%), mother was not well and doctor's advice (3% each).

A study was done on the breastfeeding practices of mothers in the urban slums. It was seen that insufficient milk production was the main reason for discontinuation of breastfeeding within 6 months[3].

Thus from the study it was concluded that wasting was double in children belonging to 4-5 years of age as compared to those belonging to 1-3 years of age. Various symptoms of Marasmus and Kwashiorkor were prevalent among the children. The rates of children suffering from frequent attacks of infections, diarrhoea and abdominal discomforts were also very high. Apart from the nutritional status of the mothers during pregnancy and lactation, age of the mothers during the first pregnancy, the number of pregnancies and also the breast feeding and weaning practices affected the nutritional status of the children.

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A Study on the Dietary Pattern and Health Implications among the Working Women in the city of Kolkata

Manila Banthia and Annalakshmi Chatterjee

ABSTRACT

Diet and nutrition are important factors in the promotion and maintenance of good health. Health and nutritional status of an individual depends on the food they eat. The components of the diet must be chosen judiciously to provide all the nutrients needed in the adequate amounts and proportion. Food habits are important part of our diet which affects the amount and type of food consumed and thus the nutritional status of the women. People are predisposed to various diseases based on their way of living and occupational habits. An attempt was made to relate the dietary pattern of working women and different health risks involved in outside the work setting. Two dietary patterns were identified one healthy and the other western type. An analysis of their dietary habits revealed that women consumed 1483.32 Kcal/day whereas protein averaged 48.50 g and fat averaged 41.87 g in the diet. Calcium and iron intake were lower in working women than the recommended values. The diets of women were mainly based on cereals and high fatty foods and deficient in fruits and vegetables. The clinical signs of stress and symptoms of headache, backache, pain in hands and legs were observed were observed.

Keywords: diet, nutritional status, dietary pattern, working women, health implications, stress levels

Introduction

There is a progressive rise in industrial employment of women and particularly after the introduction of economic liberalization in 1991. Women at work are an upcoming phenomenon in the industrialist societies, be it in the developed or developing world. Among all the industries, employment of women in corporate sectors has increased because the nature of job makes it suitable for employing women. It is expected that such employment of women leads to improved economic status and overall quality of life. It is presumed that increased income leads to improvement in health and nutritional status of women themselves. The working environment, in which women spend a significant part of their functional life, has a decisive influence on their health, safety, physical and mental and social well-being. Various evidences show that there is a direct relation between individual's nutritional status and its implication on their health thereby affecting their personal and professional life. Women are vulnerable to several weight related health risk associated with being overweight, losing weight and being underweight by choice or by circumstances. They have shorter life expectancy, experience high maternal mortality and have higher incidence of chronic disease and conditions like obesity, malnutrition, nutritional anaemia, osteoporosis, diabetes, hypertension and other cardiovascular diseases[1].

The relation between dietary intake and inactivity and the NCD's is especially strong. These factors, i.e. diets extremely high in fats (especially in animal fats), low physical activity, habitual smoking and alcohol consumption) are interrelated to each other so closely that the appearance/ occurrence of one factor paves the way for the other, thereby leading to the development of NCD's. Therefore, primordial prevention of the occurrence of risk factors, along with early identification and management can help delay the progress to NCD's[23].

Methodology

In order to study the dietary pattern and health implications of working women, 155 working women working in corporate sector in the age group of 25-35 years were selected randomly. Pregnant and lactating women were not taken into consideration. Detailed information of the socio-demographic information of the subjects, dietary intakes, anthropometric measurements, prevalence of lifestyle diseases, medical history, habits developed, type of oil used as a cooking medium, prevalence of nutritional deficiencies, work place information and the stress levels was collected using a formulated interview schedule. The assessment of nutritional status and dietary pattern of selected working women was done by adopting the following methods- anthropometric measurements namely height and weight and BMI was calculated by using a standard procedure[18]. Blood pressure was measured twice in women and evaluated using a standard procedure[13]. Standardization of food stuffs was done in the college food laboratory. The food consumption of the subjects was recorded by 24 hour recall method for three consecutive days. From the actual consumption of food daily by the

respondents, the energy, protein, carbohydrates, fats, iron and calcium was calculated using food composition table, given by ICMR, 2007[8]. The dietary pattern was assessed using a food frequency questionnaire for a complete dietary assessment. The stress levels of women were assessed using a NSAD questionnaire.

Analysis of Data

The collected data were coded, classified and put to further statistical analysis for drawing appropriate inferences.

Statistical Analysis

Percentage was tabulated for the socio-demographic profile of the subject, BMI, the medical history and habits, clinical symptoms, lifestyle diseases and the information regarding the workplace, stress levels and dietary pattern analysis. Average nutrient intake for calories, protein, fat, carbohydrates and important minerals such as iron and calcium were calculated with reference to respective body weight and height. After taking the three day dietary recall the mean and standard deviation was calculated for each nutrient using excel spreadsheet. The t-test was conducted to find whether there exist any significant difference between the mean value and the calculated RDA. Chi square distribution for independence of attributes was conducted to see the association between stress levels and various factors, i.e. clinical manifestations, habits developed at work place and lifestyle diseases.

Results and Discussion

General Profile Study of the Subjects

It was seen that of the total respondents (n=155) studied majority of them were in the age group of 29-32 years and mostly (n=124) were Hindus. Around 59% of the respondents were from a nuclear family whereas a minor stayed in extended family and a few (n=10) stayed as a paying guests. About 77% of the respondents belonged to middle income group and 9.67% of respondents belonged to low income group. The sleeping pattern showed that the maximum number respondents (56.77%) slept for at least 6-7 hours daily in a working day. Nearly three-fourth of working women under work pressure and changing lifestyle in the cities fail to secure a daily sleeping time of 8 hours during a week and insomnia among women has become a common disease[24].

Anthropometric Measurement and the Prevalence of Overweight and Obesity

It was seen that the mean height of the subjects were 158.18 cm. similarly the mean weight was seen to be 60.18 kg.

Table 1. BMI classification

CATEGORY	STATUS OF THE SUBJECTS
<18	12.26%
18.1-22.9	29.03%
23-24.9	20.65%
25-30	19.94%
30-35	12.90%
>35	5.16%

The BMI of the subjects were analyzed and the data shows the prevalence of overweight and obesity (Table 1). It has been seen that majority of women were overweight and obese. Some people were underweight by choice. They are trying to restrict their food intake in order to reduce weight. During the survey it was also found that working women generally led a sedentary life as they do most of their work sitting in front of computers and also ate high fat energy dense food outside which might lead them to overweight or obesity. It was seen that 76.78% of the respondents were not involved in any kind of physical activity and 23.22% were involved in physical activity. Out of these most were doing exercise in form of yoga, gym, walking etc. It was seen that women who do regular exercise or has an active lifestyle along with the diet can prevent a rise in LDL and weight gain especially around waist[15].

It is seen that obesity is an independent risk factors for all cause of mortality. The global epidemic of obesity continues to worsen and the ready availability of cheap and energy dense foods and increasing sedentary lifestyle are considered likely cause[7]. Obesity contributes to hypertension, high serum cholesterol, low HDL cholesterol and hyperglycemia and is independently associated with high cardiovascular risk[20].

Dietary Intake Of The Subjects

Overweight and obesity are established risk factors for heart disease. Strategies to reduce the prevalence of overweight include interventions affecting behavior, physical activity, diet and combination of all three approaches[4]. These interventions include salt reduction, dietary fibre increase and an adequate intake of fresh fruit and vegetables. Information on dietary intake using three day diet recall during working day was taken.

Table 2. Mean nutrient intake

Nutrients	RDA	Mean Intake	Difference (RDA Mean Intake)	Standard Error	t-Statistic
Energy (Kcal)	2062	1483.32	578.68	228	-31.46
Carbohydrate (g)	361.74	215.55	146.19	53.33	-33.99
Protein (g)	57.3	48.50	8.8	11.08	-9.88
Fats (g)	38.8	41.87	3.07	10.93	+3.49
Iron (mg)	30	18.41	11.59	6.79	-21.46
Calcium (mg)	600	420.63	179.37	33.78	-65.94

One of the objectives of the study was to assess the nutrient intake of the working women. This was done using the t-test statistic. It was seen that the intake of carbohydrates, protein, energy, iron, calcium was much lower than the recommended intake at 5% level of significance. Interestingly from the Table 2 it can be observed that there was an increase in the fat intake as per the recommended intake. The computed t-statistic was greater than 1.96 at 5% level of significance. The diet of working women was deficient in fruits and vegetables, milk and its products and fiber.

Dietary Pattern in Working Women

In this study of working women, two major dietary patterns were identified (Table 3). Pattern 1 was labeled "healthy" because it reflects the correlated intakes of foods commonly thought to be healthy such as fruits, green leafy vegetables, soy products, low fat dairy, whole grain breads and fruit juices. Pattern 2 was labeled as "western" because it reflects the correlated intakes of foods associated with western diets such as processed meats, soda, sweets, refined breads, potatoes and high fat dairy.

Table 3. Predicted dietary pattern of women (in %)

FOOD GROUP	DAILY	5-6 DAYS	3-4 DAYS	1-2 DAYS	NEVER
Cereals	69.93	5.63	-	14.37	80
Whole grains	84.61	-	-	-	-
Refined grains	24.1	-	-	-	-
Pulses	-	19.32	16.41	36.7	3.03
Green leafy veg	72.09	-	5.7	36.9	57.41
Root & Tubers	20.6	17.4	9.68	-	-
Other vegetables	7.10	31.61	40	7.74	-
Fruits	40.01	5.16	14.71	34.12	38.91
Meat, poultry & its products	43.92	-	19.35	2.6	41.93
Fish	30.96	-	16	-	40.08
Milk & its products	100	4.52	49.68	14.84	-
Fats & Oils	93.5	-	-	-	-
Sweets	50.32	-	-	-	-
Soda	70.1	33.54	9.03	2.58	4.51
Tea/coffee	87.32		4.25		25.74
Preserved & processes foods	-	-	-	5.67	
Wine/beer/liquor		-	-	-	90.43

The foods used daily by the subjects were cereals and fats and oils. Cereals are consumed in form of chapatti and rice. The use of rice is no doubt extensive because it is the staple food of Bengal. It was observed that refined grains were used daily by 84.61% of the subjects. Meat, poultry & its products was consumed by 40.01% of women, while 19.35% managed to have it three times a week & 41.93% never had this food. Green leafy vegetables were avoided by 57.4% of women and 36.7% consumed them once or twice a week. Fruits were consumed daily by 7.10% of women. It was observed that milk & its products were taken by 30.96% of women daily while 49.68% had it three times a week. Preserved & processed foods were consumed daily by 87% of subjects. 70% of subjects drank tea/ coffee daily and 25.74% did not have it.

Dietary pattern featured by greater intake of animal foods have been consistently associated with higher prevalence of metabolic syndrome in western populations. In contrast, studies in Iran and Korea reported a lower prevalence of metabolic syndrome in person with a higher score of healthy dietary pattern[5].

Frequency of Eating Outside

Unhealthy diet and physical inactivity are the most common risk factors for chronic diseases[23] leading to mortality and morbidity. The global epidemic of obesity continues to worsen with the consumption of ready availability of cheap energy dense foods and increasing sedentary lifestyle[7]. Thus a study on the frequency of women eating outside was carried out (Fig. 1).

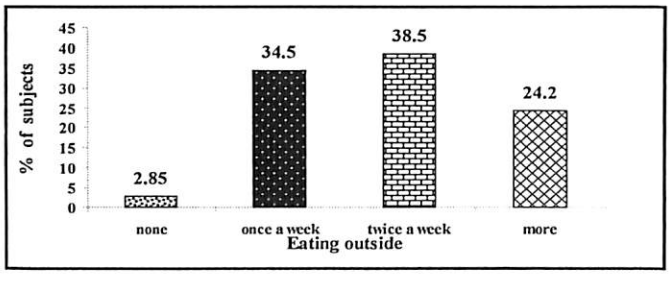

Fig 1: Frequency of eating outside

The figure clearly depicts that 34.5% of respondent ate once a week and 24.2% ate more than twice a week. Studies have shown that people eating outside are more prone to diseases than people who do not. It was seen that the working women generally ate street foods which are cheap and easily available near their work place. It was seen that fast food consumption is routinely based for obesity epidemic.

Types Of Fats/Oils Used As Cooking Medium

The role of fat intake in heart disease is now clearly established[4]. A higher intake of total and saturated fat is widely believed to contribute to the development of CHD[9].

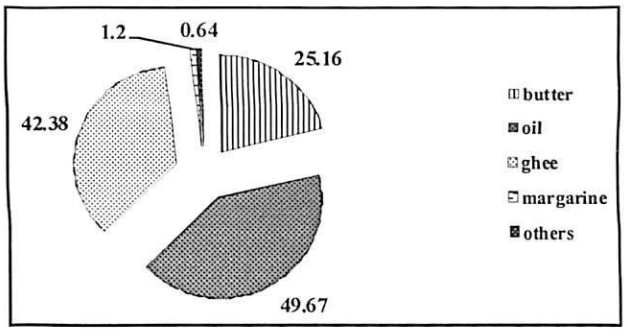

Fig 2: Type of oil used as cooking medium

From the figure 2 it was seen that majority of women (49.67%) used oil at home followed by ghee (42.38%) and butter (25.16%) and a mere group of women used margarine and other fats. These high fat intakes affect their health and give rise to various lifestyle diseases. The usage of these high saturated and trans fat medium for cooking might give rise to various chronic disorder related to fat deposition in the body.

Prevalence Of Lifesyle Diseases

Overweight and obesity are associated with chronic diseases such as hypertension, diabetes, stroke, heart disease, arthritis, asthma and some cancers[2].

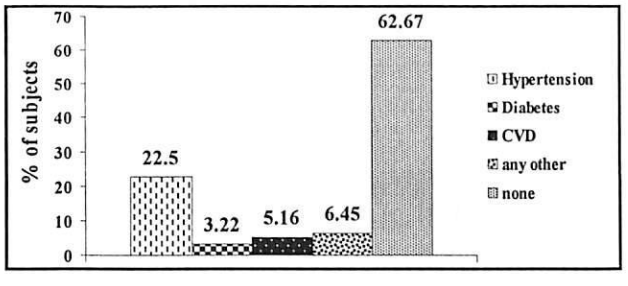

Fig 3: Prevalence of lifestyle diseases

From the study it was seen that (22.5%) suffered from hypertension, (3.22%) suffered from diabetes and (5.16%) had high cholesterol level (Fig. 3). The mean blood pressure of the subjects was around 118/79 mm Hg as the systolic and diastolic pressure respectively. Only 22.5% of the subjects had blood pressure levels of 125/82 mm Hg.

Since the subjects were working in private sectors, they might be under lot of stress which might lead to occurrences of these lifestyle diseases. These might also be due to consumption of high fat, energy dense foods, sweets and other processed foods which are readily available in the market. It was seen that most of the women belonged to overweight and obese category which might lead to hypertension, diabetes, CVD and any diseases.

Animal and human studies have shown that a diet high in salt not only increases blood pressure but also deteriorates insulin metabolism. Lifestyle related factors such as obesity, drinking habits, diet and physical inactivity are well established determinants of high blood pressure. Lack of habitual physical activity and certain dietary pattern, including high SFA and low vegetable intake contributes to weight gain and increase the risk of metabolic disturbances[6].

Habits Developed at Workplace

Habits such as chewing gum, chewing tobacco, drinking alcohol, tea/coffee increases the risk of NCD's. These habits develop as a result of stress at work, which is very much prevalent in corporate sector and hence the habits developed by the respondents were looked into. It was seen that the respondents developed habits like chewing gum, drinking alcohol, tea/coffee and smoking to combat the stress at work in Fig 4.

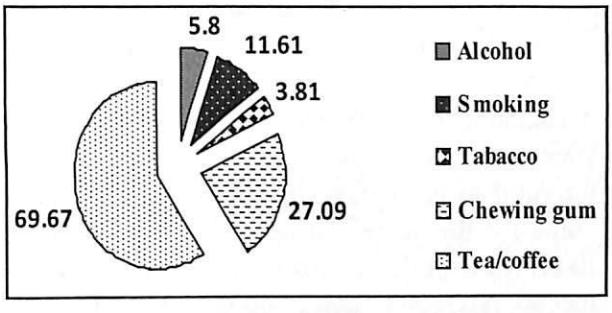

Fig 4: Habits developed at workplace

There is a strong association between the adoption of favorable habits and decrease risk of obesity and CVD, especially as regular physical activity clearly attenuates many of the health risk associated with overweight or obesity. Further a study by Thompson et.al (1998) revealed that a greater risk of heart disease in those having higher alcohol intake.

Prevalence Of Clinical Manifestations

The clinical symptoms reported among the subjects in this study were backache, headache, pain in hands and legs, cold and cough. This may be due to the considerable workload for women who spent 8-9 hours at the office[17], continued their work at home and also consumed less healthy food and eat more often junk and fatty food outside. This led to dietary inadequacies in which turn leads to related clinical problems. From the data collected it is clearly showed that 68.38% of the respondents complained of headache, 63.22% of women had backache and 61.93% of respondent had pain in hands & legs. Cold and cough, diarrhea, fever and irregular menstrual problem were also observed in some of the women.

Stress Levels of the Subject

While technologies has made aspects of many job easier, it has also added to the anxieties of office life through information overload, heightened pressure for productivity, poor working condition, relationship at work with peers, long working hours, insufficient holidays or exhaustion and impermanence in workplace. Since the subjects were working in corporate sectors, their stress level was studied, evaluated through a NSAD questionnaire (Fig. 5).

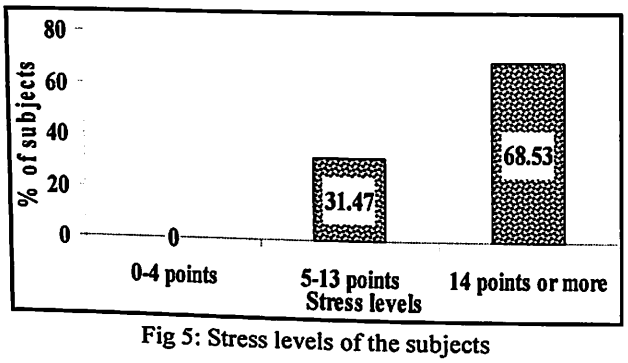

Fig 5: Stress levels of the subjects

A standard score pattern was used for analysis of stress levels in women. It was seen that 31.47% of the subjects had a score level of (5-13). The scale value for the score indicates that they are more likely to experience stress related ill health or mental, physical or both. And the other 68.53% of the respondents had a score level of (14 or more). The scale value for score indicates that these people are more prone to stress showing a great many traits or characteristics that are unhealthy behavior. This means that they are also more likely to experience stress and stress related illness like diabetes, irritable bowel, migraine, back pain, neck pain, high blood pressure, heart disease or stroke, mental ill-health, depression and anxiety.

Another objective was to examine whether habits developed at work place, clinical manifestations observed in subjects and lifestyle diseases are affected by stress levels. This was tested through chi square distribution for independence of attributes.

The conducted results show that there was a statistically significant positive association between stress and habits developed at work place and clinical symptoms observed in women (Table 4). Further it can be seen that as the level of stress increases, the chances of developing these habits increases. As the stress level increase the chances of smoking increases in women. Again it was observed that as the stress level increases more women are consuming tea / coffee to overcome stress. This was seen in a study that consuming caffeine during work increases alertness and performance at work. In score level of 0-4 only eight women had headache but as the stress level increase the pain also increases in women. But incase of stress and lifestyle diseases there was no statistically significant association found between stress and lifestyle diseases observed in women.

Table. 4. Association of stress with habits developed, clinical manifestations and lifestyle diseases

A. Association between stress and habits developed						
Stress levels	Alcohol	Smoking	Tobacco	Chewing gum	Tea / coffee	Total
0-4	3	4	1	8	2	18
5-13	3	6	3	15	23	50
14 or more	3	8	2	19	83	115
Total	9	18	6	42	108	183
B. Association between stress and clinical manifestations						
Stress levels	Headache	Backache	Pain in hands & legs	Irregular menstrual		Total
0-4	8	6	3	15		22
5-13	35	43	24	13		115
14 or more	63	49	68	23		203
Total	106	98	95	41		340
C. Association between stress and lifestyle diseases						
Stress levels	Hypertension	Diabetes	CVD	Any other		Total
0-4	10	3	1	5		19
5-13	14	-	2	3		19
14 or more	11	2	3	2		18
Total	35	5	6	10		56

Summary and Conclusion

In conclusion, two major dietary patterns were discerned from the study population, one "healthy" and other 'western' type. The present study revealed that there was a significant difference in the nutrient intake among working women at 5% level of significance. Consumption of milk and milk products, vegetables and fruits was much less than RDA. The BMI of the working women revealed that most of them were overweight and obese. The clinical signs of stress were observed in the subjects. There was a positive association seen at 5% level of significance between stress levels and these habits developed. The study also revealed a significant positive association between stress levels and clinical manifestation observed in the women. The incidence of headache followed by backache, pain in hands and legs irregular menstrual period was observed in most of them. All these complain may be due to stress at work. However there was no association observed between stress levels and lifestyle diseases in the subjects studied.

Promoting healthy diet and lifestyle to reduce the burden of malnutrition and non-communicable disease requires a multi-sectoral approach. Life style modification could be included in workplace health promotion programs.

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Risk Factor Profile of Coronary Heart Disease Patients in a Tertiary Hospital in Kolkata

Smriti Poddar and Lilu Mancha

ABSTRACT

The present study was carried out to determine the risk factors in two age groups (41-60years and 61-80years) in 155 CHD patients (90men and 60women) undergoing treatment in a tertiary hospital in Kolkata. The study was carried out using WHO STEPwise adapted questionnaire, three day dietary recall and food frequency questionnaire. The study revealed 63.3% of male and 81.54% female belong to the Bengali community. Majority of men and women suffered from angina. 71.43% of men and 82.35% of women in 41-60 years were obese while 29.41% and 70% of men and women in 61-80 years were obese. All men from both the age groups and 97.06% and 76.67% of women in the two groups had central obesity. In 61-80 years of age 88.24% and 61.29% of men and women were hypertensive while 55.88% of men were diabetic. Hyperlipidaemia was seen in 53.57% men and 55.88% of women in 41-60years compared to the older groups. The three day dietary recall showed a deficiency of carbohydrate and energy in all age groups except in 41-60year men. Protein was also deficient in all age groups. Consumption of fat was significantly higher that the RDA in all age groups. Intake of sodium, potassium and dietary fiber was low compared to RDA requirement. FFQ revealed the CHD patients still continue to have saturated fat, trans fats, processed food and salty snacks. Thus, the study highlights a burden of conventional risk factors on the CHD patients in this tertiary hospital, showing an urgent need for intervention programme.

Keywords: Coronary Heart Disease (CHD), Risk Factor, Tertiary Hospital, Dietary Recall, Food Frequency Questionnaire.

Introduction

Coronary artery disease (CAD) is the largest killer in developed countries and is rapidly becoming one in developing countries[13]. The prevalence of CHD is known to be very high in people of Indian origin[12]. A study on Global Burden of Diseases (GBD) reported the estimated mortality from CHD in India at 1.6 million in the year 2000. It is likely that among 64 million CVD cases in 2015 nearly 61 million would be CHD cases[23]. This burgeoning burden of CHD in India can be explained by the alarming rise in the prevalence of coronary risk factors like diabetes, hypertension, atherogenic dyslipidemia, smoking, central obesity and physical inactivity[8]. The risk factors of CHD are mainly the biological, physiological and behavioral risk factors.

Thus there is an urgent need has risen to see the current scenario of CHD in our respective cities. So that necessary steps can be implemented to prevent the risk factor profile of CHD in a tertiary hospital of Kolkata.

Aims and objectives

The main aim of the study was to assess and highlight the current state of the risk factor profile of CHD patients in a tertiary hospital of Kolkata. The main objective was to assess the non-nutritional risk factors and the nutritional status in the two age groups (41-60 years and 61-80 years) in men and women.

Methodology

155 CHD patients (90 men and 60 women) in the age group of 35-75years with definite diagnosis of CHD based on Coronary angiography (CAG) and Electrocardiogram reading (ECG) were selected for the study in a tertiary hospital in Kolkata. All these respondents were undergoing treatment for ≤ 1 year.

The collection of data for the research was done by detailed questionnaire adapted from WHO stepwise questionnaire, three day dietary recall and food frequency questionnaire (FFQ).

To carry out the dietary assessment, the most common recipes were standardized in terms of measuring cups, glasses and spoons in the food laboratory of J. D. Birla Institute. A three day dietary recall method was carried out and to conduct the survey the standardized cups, glasses, spoons and the different shapes and sizes of chapatti cut out on paper and food model were shown to the respondent from which they could select, the one similar to the amount they had consumed.

FFQ was used to obtain information about the long-term dietary intake as well as to get a better picture for under reported or omitted items from diet recall. It was also observed the number of times per week the processed foods were consumed- namely papad, bread, biscuits, pickles, bhujia or any other salty snacky items, as well as, information regarding the intake of different types of fatty food.

Anthropometric measurements were taken, where height was measured by Stadiometer, weight by a portable human weighing machine and waist hip circumference was taken with measuring tape. The height and weight measurements were taken to calculate the BMI of the respondents and to clas-

sify them into grades of obesity. Similarly waist hip circumference was taken to calculate waist-hip ratio to see the percentage of respondents having central obesity.

t-statistics was used for the comparison between mean dietary intake and the mean recommended dietary allowance (RDA), in an Excel spread sheet. Percentages were calculated for the rest of the data.

Results and Discussions

The data was collected and interpreted, and was observed. Majority of men and women 63.3% and 81.54% belonged to the Bengali community where as, 17.78% men and 13.85% women in this study were from the Marwari community. In fact few studies have also documented that cardiovascular disease (CVD) is a major health problem among the Bengali ethnic group[5, 6].

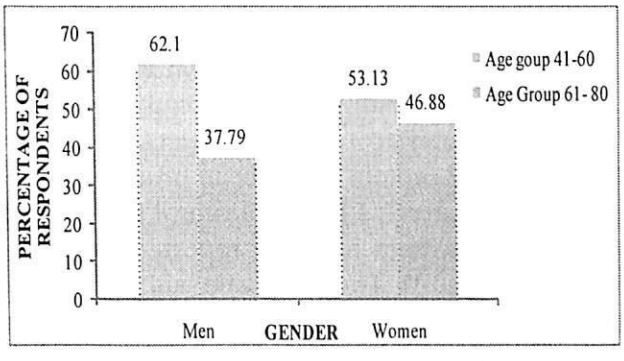

Fig 1: Incidence of CHD among the selected men and women from different age groups.

From figure 1 it was observed that the incidence of CHD was more in 41-60years than 61-80 years in both the genders. It is a well known fact that CHD is a process that usually begins in the young age. Fatty Streaks and clinically significant raised lesions increase rapidly during the 15 to 34 years of age span, with one in every six teenagers having evidence of atherosclerosis, which takes a decade for manifestation of symptoms[25]. This may be a possible reason for high percentage of CHD in the age group of 41-60 years.

It was seen that 40%, 34%, 26% women were suffered from single vessel, double vessel and triple vessel CHD while 30%, 33%, 37% men suffering from single vessel, double vessel and triple vessel CHD. All these respondents were seen to have angina pectoris. 60% men and 75.4% women respondents also showed positive first degree family history of CVD. A number of studies have shown that a positive family history of CVD can be an independent risk factor for CVD in an individual[22, 24].

Physiological Risk Factor:

Percentage of the Respondents

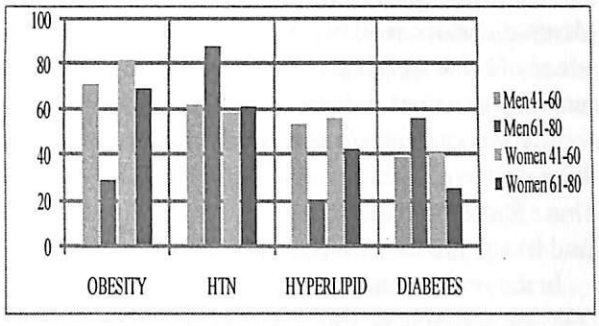

Fig 2: Incidence of physiological risk factors.

In general the physiological risk factors obesity and hypertension were seen to be the highest in this study population. 71.43% men and 82.35% women in the age group of 41-60 years were obese but, in 61-80years of age 70% of women were obese compared to 29.41% of men. 62.5% men and 58.8% women in 41-60 years and 88.24% men and 61.29% women in the 61-80 years age group were suffering from hypertension. Hyperlipidemia was found in both men and women in the age group of 41-60years while 55.9% of diabetes mellitus was observed in the older age group of men.

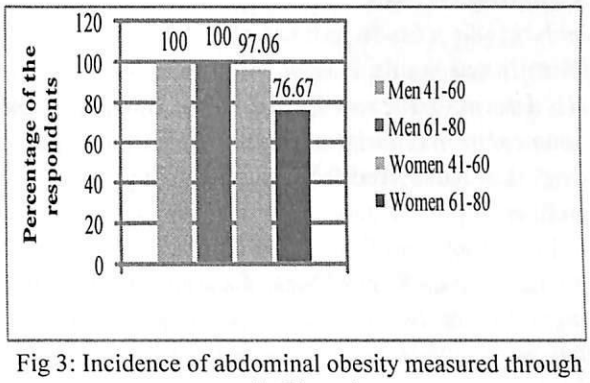

Fig 3: Incidence of abdominal obesity measured through waist-hip ratio.

It was observed from figure 3 that all the male respondents and majority female respondents in both the age groups had high prevalence of abdominal obesity. Studies have shown that abdominal obesity is a major contributor to the development of several metabolic complications like hypertension, CHD, dyslipidaemia, hyperlipidaemia and insulin resistance and NIDDM[1, 5, 7]. A study done in Andhra Pradesh showed similar results as the present study, where obesity was seen more in females(40%) than in males(35%), though central obesity was more in males(79%) than females (39%)[19].

The reason behind the high prevalence of obesity was due to physical inactivity and leading a sedentary lifestyle. 80.36% men and 94.12%

women in 41-60 years and 100% men and 90.32% women in 61-80 years, led a sedentary life. During the survey it was also found that maximum respondents did slow walking as a form of exercise instead of brisk walking. A study has shown that slow walking does not reduce the risk of CHD[20]. Most of the respondents in this study were under antihypertensive, lipid lowering and diabetic medication. Therefore their blood pressure, lipid profile and blood glucose level was more or less normal.

In the present study it was seen 80.36% men and 73.53% women in the age group of 41-60 years and, 94.12% men and 100% women in 61-80 years, were suffering from more than a single physiological risk factor. Cluster of physiological risk factors was common in the present study population thus increasing the incidence of CHD.

Behavioral Risk Factors

It was seen 50% of men in the age group of 41-60years continued to smoke even after diagnosis of CHD. It is to be mentioned 39% of these men were ex-smokers. Studies have shown that smoking 1-4 cigarettes per day raises the risk of CAD[17], and 26.79% men in 41-60years had more than 4 cigarettes per day.

Nutritional Status

To determine the nutritional status of the patients macronutrients protein, fat, carbohydrates and energy was calculated from the three day dietary recall.

Table 1: Comparison of Mean fat intake of the CHD males and females in the two age groups with mean Recommended Dietary Allowance (RDA).

Gender	Age group	Mean RDA Value of Fat (gms)	Mean Fat (gms)	Difference (RDA - Mean)	Standard Error	Value of computed t-Statistics
Male	41-60 years	37.9	58.18	20.28	12.87	11.79
	61-80 years	37.66	47.95	10.29	13.03	4.61
Female	41-60 years	38.4	50.82	12.42	16.33	4.43
	61-80 years	36.99	53.24	14.25	19.49	4.64

Significant difference in the mean fat intake with the mean RDA was observed in all the respondents by applying the t- statistics(5% level of significance). Hence, their average fat intake was higher than the average RDA in both the genders of all the groups.

On comparing it with the average RDA of the respective nutrients it was observed, the mean protein intake of women in both the age groups was found to be significantly lower than their mean RDA but a reverse trend was seen in 41-60 years old men. The mean carbohydrate intake in 41-60 year old men was high though in 61-80 year old women was lower to the mean RDA, having significant difference between the mean intake and mean RDA showing faulty dietary habits of these CHD respondents. Only the men belonging to 41-60 years showed a significant difference in the energy intake, with mean kilocalorie consumption being higher than the average RDA. This might have been due to their overall high intake of fat and carbohydrate in the diet, which in turn might have led to the incidence of obesity in these men along with sedentary lifestyle. Though the mean energy intake in rest of the respondents had no significant difference from the mean RDA, it was seen that the maximum kilocalorie obtained in the diet was from fat which led to CHD.

In the present study the source of protein in the diet of 80%male and 81% female respondents was seen to be of animal origin and studies have shown animal source of protein is high in cholesterol and sodium[14]. Studies have shown that in hypercholesterolemic patients who are already on a low-lipid, low cholesterol diet for 8 weeks' substitution of animal protein by soybean protein reduces plasma cholesterol, LDL cholesterol and triglycerides. Soy protein has also reported to reduce blood pressure[4, 16]. Thus it may be said that, though the average protein intake was high in men belonging to 41-60year and low in women belonging to both the age group and men in 61-80years, none of these respondents chose the miracle soy protein in their diet.

Table 2: Number of the respondents not consuming SFA and TFA after diagnosis through Food Frequency Questionnaire.

Food item	Men 41-60 years N= 56	years 61-80 years N= 34	Women 41-60 years N= 34	Women 61-80 years N= 34
Ghee/butter	11	11	11	3
Sweets/dessert	5	1	0	0
Fried food	4	3	1	2
Packaged food	1	1	4	2
Red meat	38	31	24	26
Milk	16	5	7	2

On conducting the FFQ to get a detailed picture of the fat intake by the respondents it was seen that even after being diagnosed with CHD only very few respondents stopped consuming foods high in saturated fatty acid trans saturated fatty acid namely ghee/butter, and fried food thus increasing their fat intake in the diet. They also continued to consume sweets and packaged foods. Studies have shown Trans fatty acids elevate the level of Lp (a), an independent risk factor for CHD[2]. This fact is critically important in Asian Indians where one of the highest levels of Lp (a) has been recorded and cor-

related to CHD[9]. In the present study most of the respondents in all the age group had stopped consuming red meat. On the other hand, a reverse trend was noticed in the consumption of fish.

The intake of micronutrients namely dietary fiber, sodium and potassium was also calculated for all the respondents.

Table 3: Comparison of Mean dietary fiber intake of the CHD males and females in the two age groups with mean Recommended Dietary Allowance (RDA)

Gender	Age group	Mean RD Value of Dietary fiber (gms)	Mean Dietary fiber (gms)	Difference (RDA-Mean)	Standard Error	Value of computed t-Statistics
Male	**41-60 years**	37.87	17.16	20.71	3.87	-39.36
	61-80 years	37.28	14.05	23.23	3.34	-40.57
Female	**41-60 years**	38.02	23.02	15	5.72	-15.3
	61-80 years	36.63	21.76	14.87	5.04	-16.42

The above table showed that significant difference in the mean dietary fiber intake with the mean RDA was observed in all the respondents by applying the t- statistics. According to the negative sign of the t-statistics the average dietary fiber intake was lower than the average RDA.

All the respondents other then 41-60year old men showed significant difference in the average sodium intake and average RDA, by having mean sodium intake lower than the mean RDA. The potassium intake of all the respondents was very low, showing significant difference between the average potassium intake and average RDA. In fact the potassium intake of men belonging to age group of 61-80years was -2196.18mg. According to ICMR the recommended intake viewed as safe and adequate is 1875-5625 mg daily[23] and these respondents consumed only 1541.69mg of potassium. A study has shown that low dietary potassium is an independent risk factor for stroke[6] thus showing an increased risk for all the respondents especially for men in the age group of 61-80years. This could be due to the inadequate intake of fruits and vegetable in their diet.

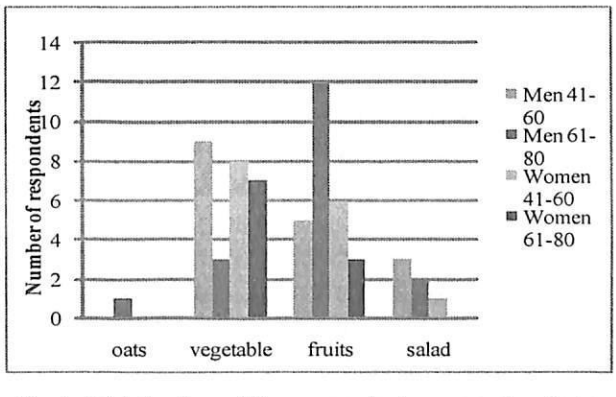

Fig 4: Distribution of the respondents consuming dietary fiber daily after diagnosis through Food Frequency Questionnaire

On conducting the FFQ it was found that negligible number of respondents consumed oats, vegetables, fruits and salads daily (Fig 4). Maximum respondents opted for refined cereal products rather than fiber rich foods. Several large cohort studies carried out in different countries have reported that a high fiber diet as well as a diet high in wholegrain cereals lowers the risk of coronary heart disease[18, 21]. It is said that most fibers reduce plasma total and LDL cholesterol, as reported by several trials[3]. The respondents were seen to have processed and salty snacks like bhujia, maggi, papad, etc even after being diagnosed with CHD thereby increasing the sodium in the diet. Thus, it may be said that during dietary recall the intake of salty snacks and processed food by the respondents was not mentioned. Numerous studies and clinical trials have demonstrated that a high intake of sodium can result in increased blood pressure (BP) and the reduction of sodium intake lowers the BP in the majority of people[15] and we know that hypertension leads to CHD. Thus in the present study low dietary fiber and high intake of sodium became a prominent risk factor.

Conclusion

Thus it can be concluded that obesity, physical inactivity, hypertension, hyperlipidaemia, high fat and sodium intake are the most predisposing risk factor in the CHD patients of this tertiary hospital. It also showed a high prevalence of clustered physiological risk factors like obesity, hypertension, hyperlipidemia, diabetes mellitus which tend to increase the incidence of CHD. It was observed that the patients continued to consume unhealthy foods which may further aggravate their condition. Thus we may conclude that the incidence of CHD patients undergoing treatment in a tertiary hospital of Kolkata is very high which should be the prime concern now with increasing prevalence of CHD in India. Thus interventional programme should be conducted to educate these patients regarding lifestyle pattern and dietary modification.

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To study the effect of sulphur containing foods on lipid oxidation

Shruti Agarwala and Banani De

ABSTRACT

Oxidative degradation of oil reduces its biological importance. To study oxidative stability, fritters of vegetables rich in organosulphurous antioxidants (one-pod garlic, garlic, bulb onion, onion from allium family and cabbage, cauliflower, broccoli, kohlrabi from cruciferous family) were fried in three oils, soybean, rice bran and sunflower for 3, 9 and 15 minutes and were compared against vegetable-free fritters as control and with only oil exposed to similar frying condition. Oxidative stability of oil were evaluated by peroxide, thiobarbituric acid, para-anisidine, fatty acid, conjugated diene and triene values, oryzanol content and antimicrobial effect against Escherichia coli and Bacillus subtilis. Overall oxidation order was rice bran>sunflower>soybean oil. Kohlrabi transferred remarkably high sulphur on frying to oil. Malonaldehyde declined remarkably on frying one-pod garlic fritters in soybean oil. A high positive correlation was observed between peroxide and para-anisidine value except in cauliflower in rice bran oil. Only cabbage and cauliflower could decrease acid value in soybean oil. A significant effect of vegetables and varying frying times was observed on the para-anisidine values of the oils ($P<0.05$). Conjugated triene value decreased in one-pod garlic, onion and cabbage in sunflower oil and cabbage and cauliflower in rice bran oil. The d-oryzanol levels increased on frying garlic and bulb onion in all the oils and cabbage in rice bran oil. Cabbage and cauliflower exhibited antimicrobial properties against Bacillus subtilis and Escherichia coli respectively in all three oils whereas allium vegetables exhibited same in selective oils.

Keywords - Oxidative Parameter Lipid Oxidation, MDA, CruciferousVegrtables

Introduction

Lipids are esters of fatty acids and glycerol. Fatty acids are aliphatic carboxylic acids and occur in chains which may be saturated or unsaturated[12]. Oxidation of lipids is influenced by fatty acid, composition of lipid, processing, light exposure, concentration of oxygen, transition metals, thermally oxidised compounds, type of container of frying, nature of food fried and presence of pigments[4]. The rate of formation and the amount of primary oxidation compounds accumulation at the end of induction period increases with increased degree of unsaturation[12].

Vegetable oils are triglyceride extracted from various plant sources. Soybean oil is extracted from the seeds of the soybean. The seed contains 19% of oil. Linolenic acid which is responsible for flavour instability of soybean oil is considered as the primary factor contributing to deterioration of this oil[7]. 4-hydroxy-*2-trans*-nonenal (HNE, a mutagenic and cytotoxic product of the peroxidation of linoleic acid) in soybean oil increases with longer exposure to frying temperature[2]. Rice bran fraction contains 12%-13% oil and highly unsaponifiable components (4.3%). This fraction contains tocotrienols (a form of vitamin E), gamma-oryzanol and beta-sitosterol[13]. d-Oryzanol, found in considerable amounts in rice bran oil is a mixture of ferulic esters sterols and triterpene alcohols[13]. Sunflower oil is non-volatile oil compressed from sunflower (*Helianthus annuus*) seeds. It is mono unsaturated and polyunsaturated (MUFA/PUFA) oil of oleic-linoleic acid group of oils. The oil contains appreciable quantities of vitamins A, D and E, sterols, squalene, and other aliphatic hydrocarbons, terpene and methyl ketones (chiefly methyl nonyl ketone).

Deep fat frying is a complicated thermal chemical process in which fats and oils undergo deteriorative changes. Rancidity or spoilage of fats and oils occur because of hydrolytic rancidity or oxidative rancidity or polymerization reaction.

Assessment of the effect of frying organosulphur antioxidant rich vegetables on the oxidative stability of frying oil is thus relevant from nutritional point of view.

Materials and methodology

Among the cooking oils, soybean oil, rice bran oil and sunflower oil were selected.

Selection of vegetables to be used in frying

Amaryllidaceae family - The 4 varieties used were onion (*Allium cepa*), bulb onions (scientific name – *Allium aggregatum*), garlic (*Allium sativum*) and one-pod garlic (scientific name — *Allium oleraceum*).

Brassicaceae family - Cabbage (*Brassica oleracea*), cauliflower (*B. oleracea,* var. *capitata*), broccoli (*B. oleracea,* var. *gongylodes*) and kohlrabi (*B. oleracea,* var. *botrytis*) were the selected members of this family.

Sample preparation and frying operation

Recipe for 10 fritters: Bengal gram flour - 10 grams, vegetable (finely chopped) - 10 grams, water - 10 ml, salt - 1 gram

The batter was prepared and 10 small round fritters were fried for 3 different time limits, 3, 9 and 15 minutes. A volume of 50 ml of each type of oil was heated to respective smoking point in Teflon coated frying pan and fritters were fried. Each set was repeated thrice. After frying the samples were poured in dark coloured glass containers till the brim leaving no head space to ensure no oxidation and refrigerated.

The entire operation was done on a triplicate basis.

Physico-chemical Tests

Colour Index

Absorption of the oil samples at 420 nm was determined on a UV – Spectrophotometer (U – 2000, Hitachi, Tokyo, Japan) and the values were taken against water as blank.

Viscosity

Viscosity was measured by using Ostwald's Viscometer.

Sulphur Test

It is done for only for the oil in which piyaji was fried.

Chemical Tests

Antioxidant assays

Determination of total phenolic compounds

Total phenolic compound was determined using Folin-Ciocalteu reagent

Antioxidant activity in a linoleic acid system

Antioxidant activity was evaluated by the thiocyanate method

Oxidative parameters

Peroxide value

Peroxide value was calculated using IUPAC method 2.501.

Thiobarbituric acid number

Thiobarbituric acid value was calculated using IUPAC method 2.531.

Acid value

Acid value was calculated using IUPAC method 2.201.

Para-anisidine value

Para-anisidine value was calculated using IUPAC method 2.504.

Total Oxidation value

Total Oxidation value was calculated as follows:

Total Oxidation value = 2 x Peroxide value + *para*–anisidine value

Conjugated diene and triene value

These values were calculated using IUPAC method 2.505.

d-Oryzanol estimation

Sample was prepared by dissolving 0.03 grams of sample in 100 ml of ethanolic solution. Absorbance was measured at 325 nm in quartz cell of 10 mm. Quantity of oryzanol % = E x 100/W x 359

Antimicrobial activity

Preparation of test organisms

The cultures of test organisms (Escherichia coli and Bacillus subtilis) were maintained in agar slants at +4°C. Bacterial inoculums obtained from these reference stock cultures were inoculated in nutrient agar medium, which was incubated at 37°C for 18-24 hours. Fresh grown cultures were inoculated in sterile lactose broth.

In vitro antimicrobial activity testing

Sterile petriplates using nutrient agar medium were prepared and 100µl of oil samples were poured in each plate before the agar had solidified. Then 10µl of inoculums prepared in lactose broth of both the bacterial strains were added to the plate. They were kept at 37°C for 24 hours and the colony count (CFU/ml) was calculated.

Statistical analysis

The data was reported as mean (n=3) ± SD (n=3). Students' correlation tool was used to find the relationship between two parameters. Statistical analyses of the data were performed by split-plot design Analysis of Variance (ANOVA). Probability value of $P \leq 0.05$ was considered to denote the statistically significant differences at 5% level of significance.

Results and discussions

Antioxidant activity of oil

Three commercially available oils, soybean, rice bran and sunflower were selected as frying medium and evaluated for antioxidant activity. The estimation was done on the basis of inhibition to peroxidation in linoleic acid system and total phenolic content. Phenol content of the oils can be arranged in the order soybean>rice bran>sunflower. This order perfectly corroborated with the linoleic acid system.

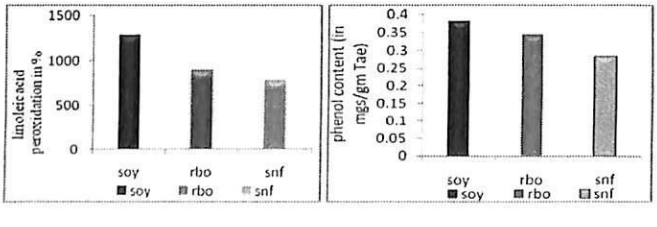

Fig. 1: Graphs showing antioxidant activity of 3 types of oil.

The fritter fried oils were evaluated for oxidative degradation. Oil in which fritters were fried without any vegetable was considered as control. Oil heated without frying fritters was also taken for comparison.

Physico-chemical parameters

Colour index

Colour index reflects over degradation of oil. All the samples showed increasing trend in colour intensity with respect to increase in frying time. The overall increase in colour intensity may be due to pigments of the vegetables or oxidative products formed with frying. The colour index order of the three oils can be arranged as, sunflower oil<soybean oil<rice bran oil. It should be emphasized that the initial colour intensity of the rice bran oil was highest even before frying.

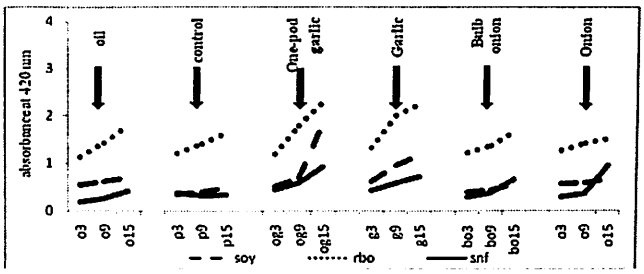

Fig. 2.a: Graph showing colour index in *allium* family in 3 types of oil with increasing frying time.

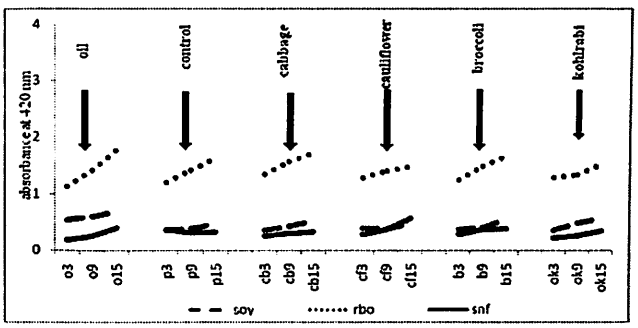

Fig. 2.b: Graph showing colour index in cruciferous family in 3 types of oil with increasing frying time.

Viscosity

All three varieties of oil in which vegetable fritters were fried and the control samples had undergone a steady increase in the viscosity. Maximum value was obtained in case of rice bran oil in which the fritters were fried. Oil in which no fritters were fried followed the order, soybean > sunflower > rice bran.

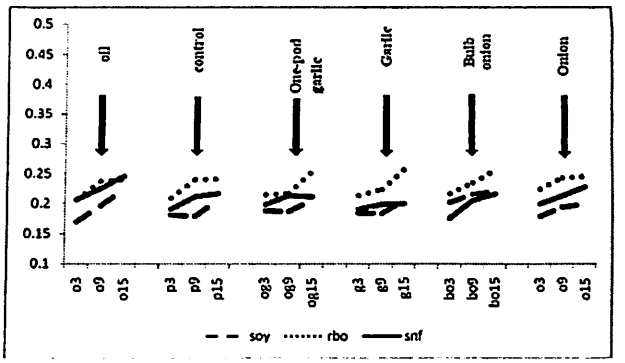

Fig. 3.a: Graph showing viscosity in allium family in 3 types of oil with increasing frying time.

Kohlrabi has recorded an exceptionally high viscosity value of 0.31 in rice bran oil where as others have mostly exhibited a range of 0.15-0.25. Contrary to rice bran oil, soybean oil and sunflower oil exposed to frying operations have recorded lower viscosity values than the oil which was only heated for similar time duration. It indicates that along with oxidative changes the compounds that were formed during frying fritters using the vegetables also affect the viscosity of the oil.

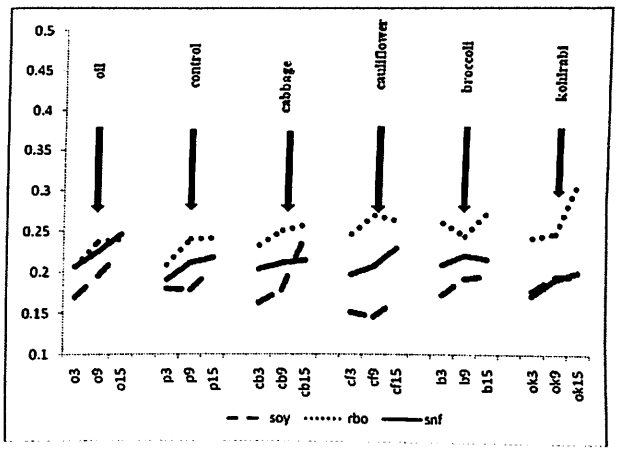

Fig. 3.b: Graph showing viscosity in cruciferous family in 3 types of oil with increasing frying time.

Sulphur content

Presence of sulphur in the oil might play an important role in increasing the viscosity of the frying oil. Values of all three types of oil in which the vegetable fritters were fried had exhibited an overall rise in value with increase in frying duration. In some cases, there were initial slight decline in the sulphur. Oil in which kohlrabi was fried showed maximum sulphur content (as high as 7mgs in case of rice bran oil).

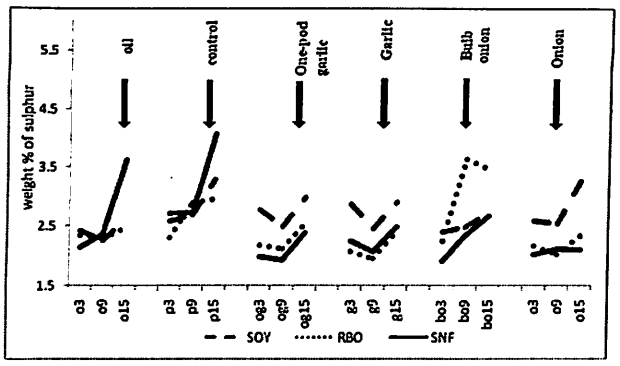

Fig. 4.a: Graph showing the sulphur content (in mgs) in allium family in 3 types of oil with increasing frying time.

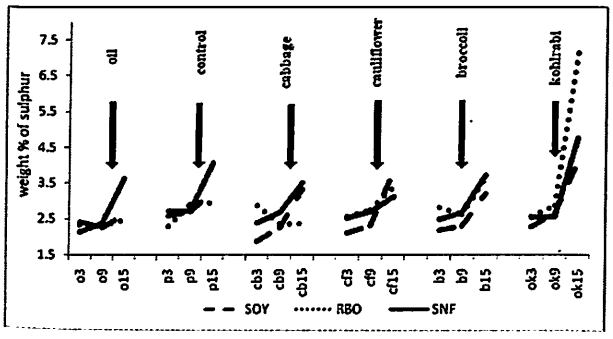

Fig. 4.b: Graph showing the sulphur content (in mgs) in cruciferous family in 3 types of oil with increasing frying time.

Oxidative parameters

Peroxide value

Among the three oils, rice bran oil has shown maximum peroxidation. Allium vegetables were able to reduce or at least control peroxide formation in both soybean oil and sunflower oil till a certain period of time. But the resistance reduced and high amounts of peroxides were formed with increasing frying time. The bulb onion fritters fried rice bran oil showed an increase followed by a decrease which indicated a rapid formation as well as rapid decomposition of peroxides.

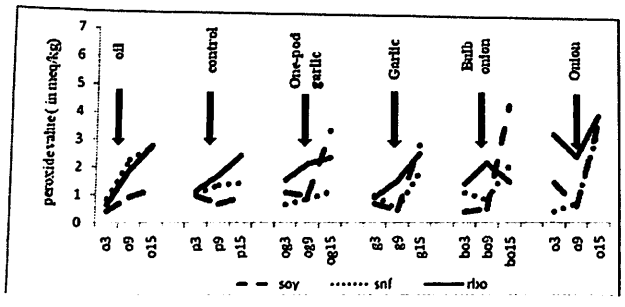

Fig. 5.a: Graph showing the peroxide value in allium family in 3 types of oil with increasing frying time.

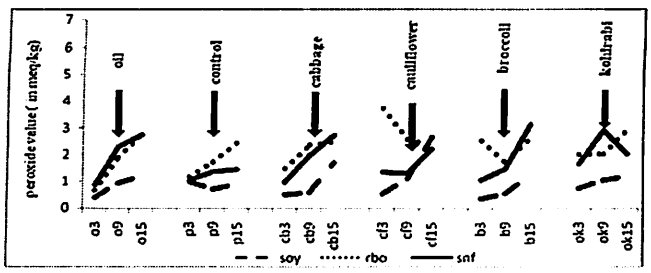

Fig. 5.b: Graph showing the peroxide value in a cruciferous family in 3 types of oil with increasing frying time.

Majority of all cruciferous vegetables have shown an increase in the rate of peroxidation till a certain period of time. Exception were cauliflower in sunflower oil and broccoli in rice bran oil which showed decreasing followed by increasing trend and cauliflower in rice bran oil had shown a steadily decreasing trend.

Thiobarbituric acid number

TBA number indicates the amount of non-volatile aldehydes including malonaldehyde formed during primary oxidation. Soybean oil recorded highest values in TBA number whereas rice bran and sunflower oil had values in the same range. One-pod garlic in soybean oil had decreased the malonaldehyde formation markedly. Garlic in sunflower oil could reduce the malonaldehyde formation initially but subsequently increased. Others showed a steady increase or an initial increase with a subsequent decrease. None of the cruciferous vegetables could reduce the malonaldehyde production in frying oil. This indicates that organosulphur present in these vegetables were not able to reduce the primary oxidation state rather the malonaldehyde production.

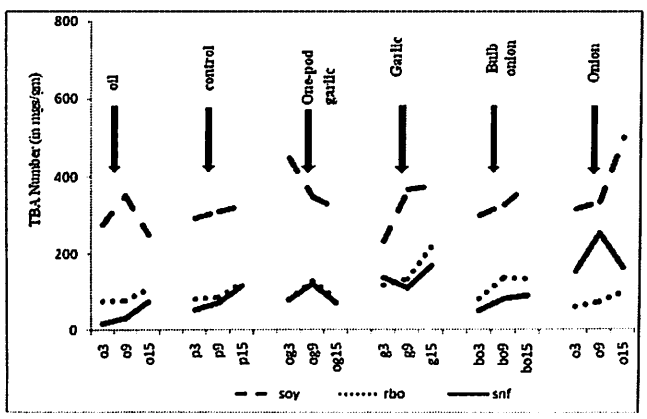

Fig. 6.a: Graph showing the TBA number in allium family in 3 types of oil with increasing frying time.

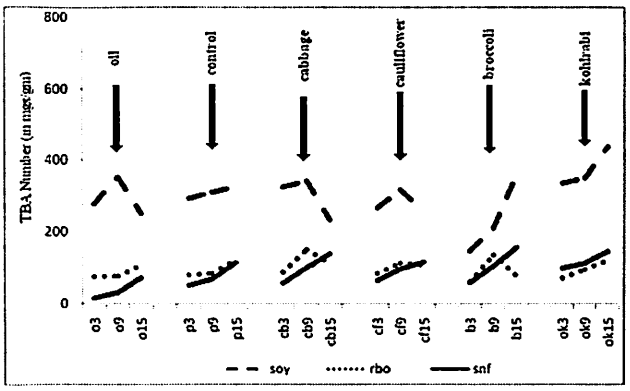

Fig. 6.b: Graph showing the TBA number in cruciferous family in 3 types of oil with increasing frying time.

Acid value

Acid value is an indicator of the amount of free fatty acid content formed during primary oxidation[3, 4]. According to acid value formation oil can be arranged as soybean oil > rice bran oil > sunflower oil.

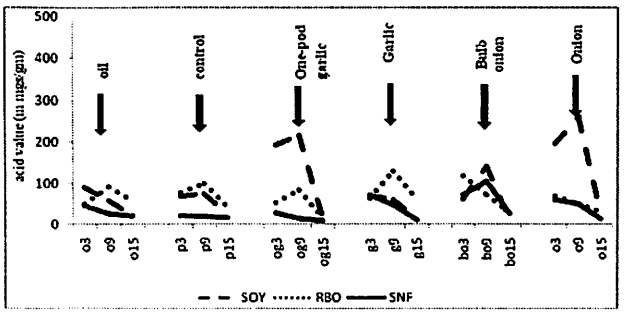

Fig. 7.a: Graph showing the acid value in allium family in 3 types of oil with increasing frying time.

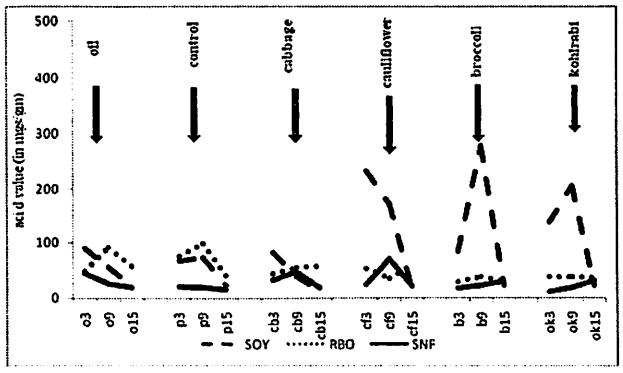

Fig. 7.b: Graph showing the acid value in cruciferous family in 3 types of oil with increasing frying time.

Garlic in soybean, bulb onion and onion in rice bran and one-pod garlic, garlic and onion in sunflower oil has shown a steady decrease in free fatty acid content during increase in successive frying times. In rice bran cauliflower exceptionally showed a initial decrease in the free fatty acid content which later increase with increasing frying time. In soybean oil, cabbage and cauliflower however showed a reduction with increase in frying time to as low as 13.61 and 14.92 respectively from an initial value of 82.77 and 230.66 respectively.

Para-anisidine value

Para-anisidine indicates aldehyde formation during secondary oxidation of fats and oils [11]. The results of *para*-anisidine value in three types of oil in which allium and cruciferous vegetables were fried as well as the control showed a steady increase with three consecutive increasing frying times. Among the three types of oil, rice bran oil has the highest range of values (approx. 13–25) followed by sunflower oil and soybean oil.

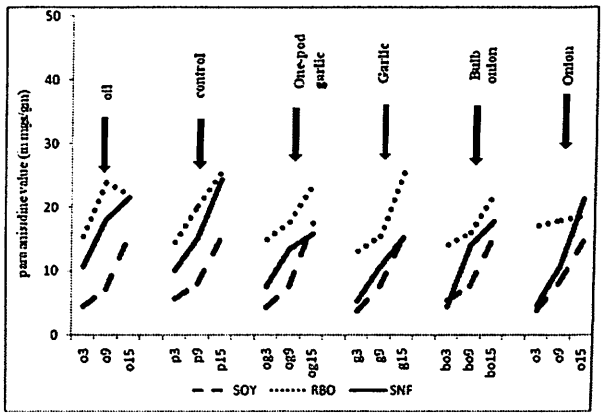

Fig. 8.a: Graph showing the *para*-anisidine value in allium family in 3 types of oil with increasing frying time.

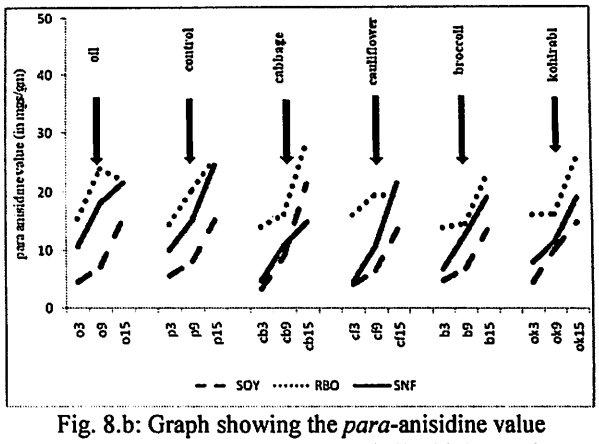

Fig. 8.b: Graph showing the *para*-anisidine value in cruciferous family in 3 types of oil with increasing frying time.

TOTOX number

Total oxidation number indicates the overall oxidation state of the lipid; both primary and secondary. Rice bran oil has the highest succeptibility to oxidation followed by sunflower oil and then soybean oil. In onion fried rice bran oil values increased subsequently with time but in an unusually low difference (41.04 < 41.14 < 45.40). This represented a diminished though increasing rate of oxidation with increasing time.

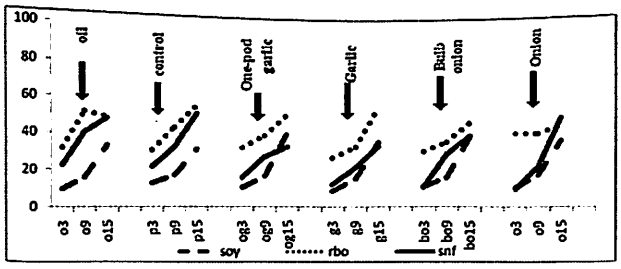

Fig. 9.a: Graph showing the total oxidation number in allium family in 3 types of oil with increasing frying time.

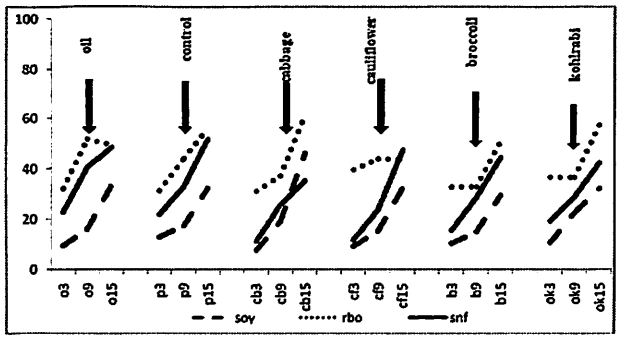

Fig. 9.b: Graph showing the total oxidation number in cruciferous family in 3 types of oil with increasing frying time.

Broccoli and kohlrabi in rice bran oil could control oxidative detoriation but till a certain time period. It should be emphasised that cauliflower fritters fried rice bran oil exhibited almost no increase in oxidation from 9 minutes to 15 minutes frying.

Conjugated diene and triene values

The non-conjugated double and triple bonds that are present in natural unsaturated lipids are converted to conjugated double and triple bonds. Sunflower oil recorded the highest conjugated diene values followed by rice bran oil and soybean oil with the least range of values. One pod garlic in soybean and onion in all 3 types of oil had lesser conjugated diene formation than other vegetables of allium family and control. Cabbage in sunflower oil and kohlrabi in soybean oil however had shown steady decline in the same. All the three oils exhibit a similar range of values when conjugated trienes are considered. In sunflower oil, one-pod garlic and onion was able to reduce the formation of conjugated trienes. Cabbage in rice bran and sunflower oil and cauliflower in rice bran oil also illustrated similar picture.

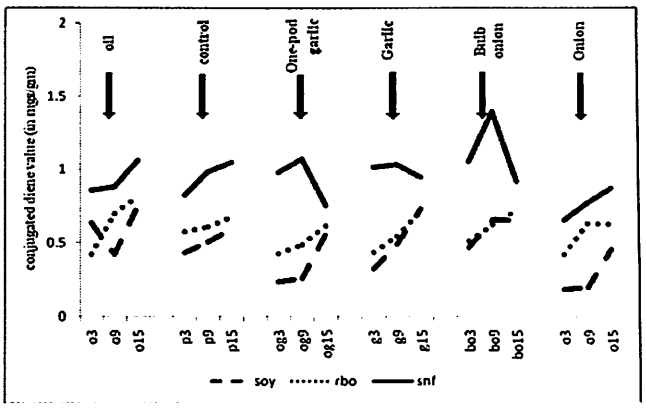

Fig. 10.a: Graph showing the conjugated diene value in allium family in 3 types of oil with increasing frying time.

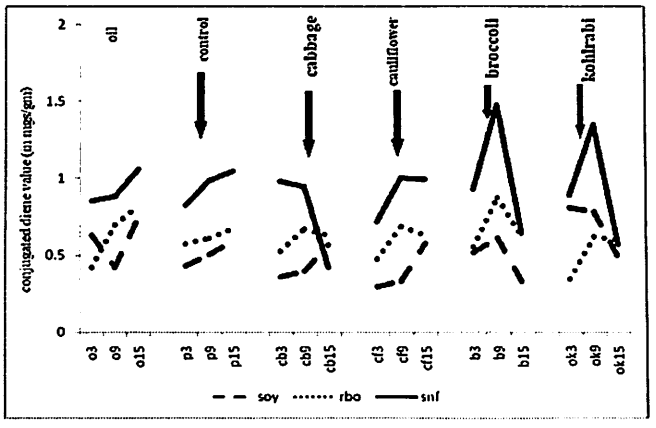

Fig. 10.b. Graph showing the conjugated diene value in cruciferous family in 3 types of oil with increasing frying time.

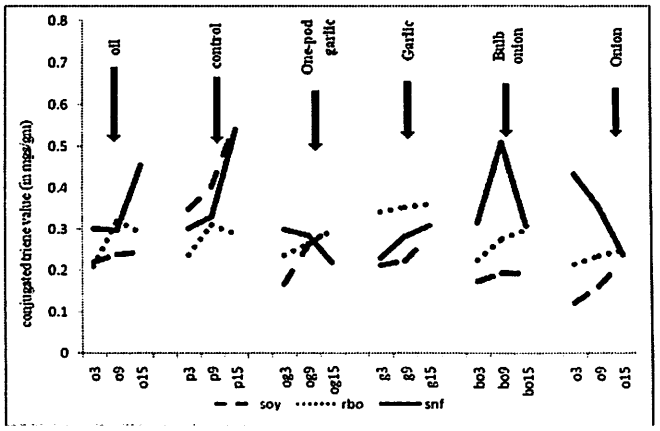

Fig. 10.c: Graph showing the conjugated triene value in allium family in 3 types of oil with increasing frying time.

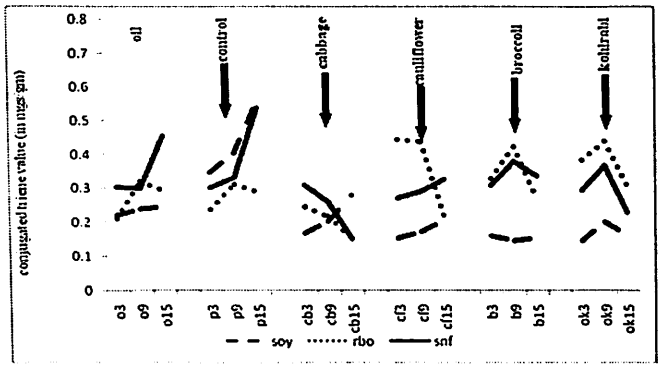

Fig. 10.d: Graph showing the conjugated triene value in cruciferous family in 3 types of oil with increasing frying time.

Oryzanol content

d-Oryzanol is a natural antioxidant retained during heat treatments like frying[10]. In case of sunflower and soybean oil in which no vegetables were fried; initial rise was observed in oryzanol content with increasing time duration while control samples fried rice bran oil showed remarkable increase in the value.

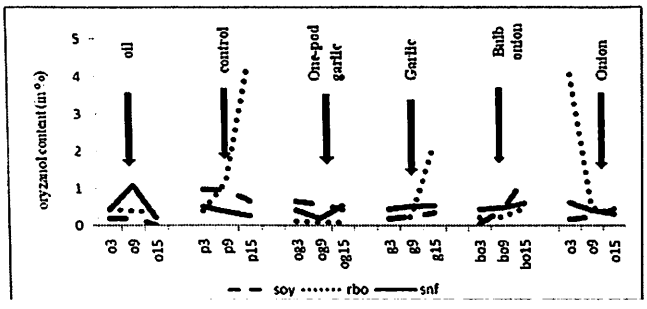

Fig. 11.a: Graph showing the oryzanol content in allium family in 3 types of oil with increasing frying time.

One-pod garlic fried sunflower oil represented sharp increase in oryzanol during 15 minutes frying. In all three garlic and bulb onion fried oils, oryzanol increased with longer frying duration and a notable increase (0.19>0.23>2.2) was observed in garlic fried rice bran oil. Onion exhibited slight and gradual increase in the values in soybean oil with increasing frying time.

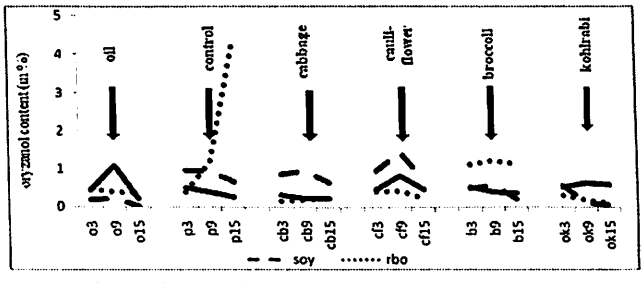

Fig. 11.b. Graph showing the oryzanol content in cruciferous family in 3 types of oil with increasing frying time.

Except cabbage and broccoli in sunflower oil and kohlrabi in soybean and rice bran oil, all others had depicted an initial increase in oryzanol though it declined later. However, cabbage in rice bran oil exhibited a gradual increase.

Anti microbial effect

Oil and its components are able to inhibit growth of certain microorganisms[1, 5]. Again vegetables contain some compounds that have inhibitory or growth promoting effect on microorganisms[6, 9].

Growth of Escherichia coli studied using the samples depicted that in oil exposed to degradation, there was a gradual decrease in the CFU. In soybean oil, control and one-pod garlic and in rice bran oil, garlic and onion had showed an increasing while all others had shown a decreasing pattern in the values with longer frying duration. Among the cruciferous vegetables, cabbage and cauliflower in sunflower oil, cauliflower, broccoli and kohlrabi in rice bran oil and cauliflower in soybean oil have exhibited gradually decreasing CFU with increasing frying duration.

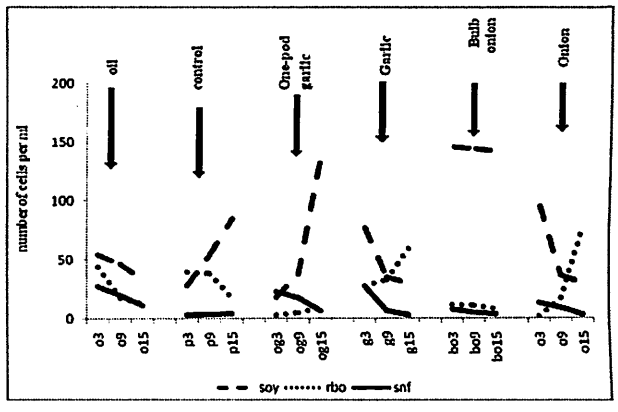

Fig. 12.a: Graph showing effect of the allium family in three different types of oil on the growth pattern of E. coli.

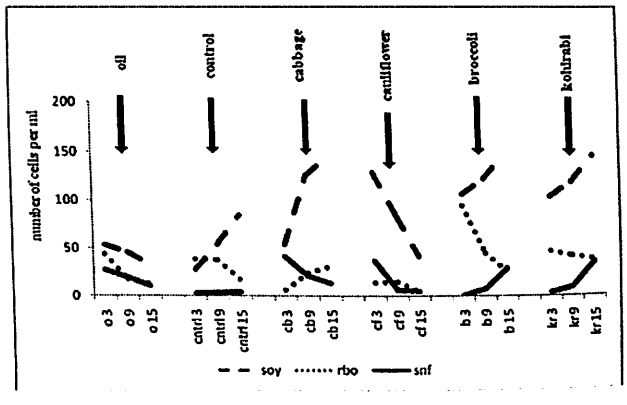

Fig. 12.b. Graph showing effect of the cruciferous family in three different types of oil on the growth pattern of E. coli.

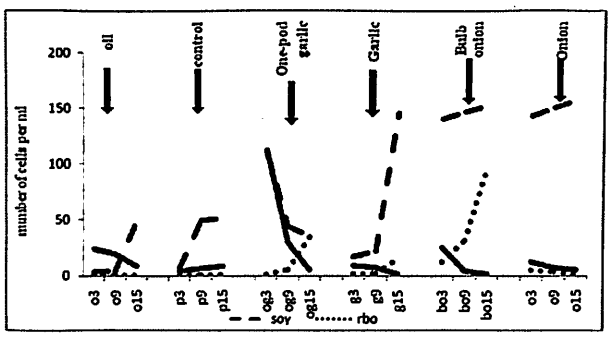

Fig. 12.c: Graph showing effect of the allium family in three different types of oil on the growth pattern of Bacillus subtilis.

When effect of oil samples were examined on Bacillus subtilis, it was seen that all the allium vegetables fried in sunflower oil and the oil without the vegetables had undergone a decrease in values with increasing frying time. One-pod garlic fried soy bean oil, and rice bran oil used for onion fritters as well as without fritters has shown a reduction in the colony forming units with increase in frying duration.

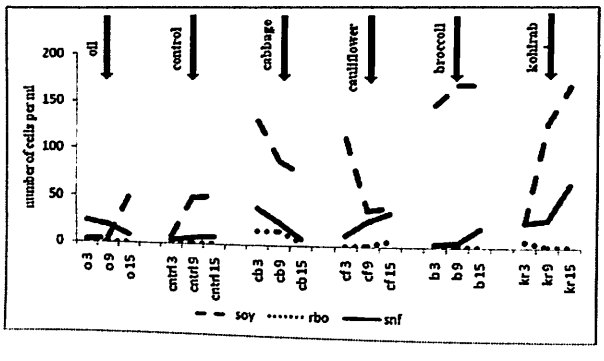

Fig. 12.d: Graph showing effect of the cruciferous family in three different types of oil on the growth pattern of Bacillus subtilis.

Cabbage has showed a decrease in the CFU in all three oils. In cauliflower fritters fried soybean oil and rice bran oil in which broccoli and kohlrabi fritters were fried also exhibited a decreasing pattern in the values with respect to increasing frying time.

The increase in values with increasing frying time may be due to compounds formed during the oxidative degradation. These compounds may induce the growth of the bacteria by serving as medium for nutrition. However some antioxidants like quercetin present in the vegetables might have inhibitory effect on the growth of microbes[6, 9]. This might cause decrease in the bacterial growth.

Statistical analysis

The overall view of the results of the ANOVA indicted that the variation in the vegetable had significant impact on the oxidative parameters. Thus it can be said that the vegetables had a control on the oxidation of oil. In contrast, oryzanol content was controlled by all the three variables; oil, vegetables as well as duration of frying. The bacterial strains responded to the variation in frying time as well as the assorted vegetables.

Conclusion

Overall oxidation order was rice bran > sunflower > soybean oil. One-pod garlic was able to reduce malonaldehyde formation in soybean oil. A high positive correlation was observed between peroxide and *para*-anisidine value except in cauliflower in rice bran oil. One-pod garlic, onion, cabbage and cauliflower could reduce the CT value in selective oils. The d-oryzanol levels increased on frying garlic and bulb onion in all the oils and cabbage in rice bran oil. Cabbage and cauliflower exhibited antimicrobial properties against *Bacillus subtilis* and *Escherichia coli* respectively in all three oils whereas allium vegetables exhibited same in selective oils.

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A Comparative Study on the Benefits of Flavoured Black Tea

Aditi Khanna and Sonali Ghosh

ABSTRACT

Tea is the most widely consumed beverage in the world and black tea possesses many biological effects on the organisms. In this study an attempt was taken to evaluate the benefits of flavoured black tea. Antioxidant properties of commercially available flavoured black teas and newly developed, Apple Ginger tea and Mausumbi Ginger tea were evaluated and compared with control black tea. Folin Ciocalteau (FC) assay, DPPH assay, vitamin C assay and tannin estimation assay were used for these purposes. It was found that vitamin C content in the tea infusions increased in the order, control black tea < flavoured black tea < newly flavoured black tea. Whereas the antioxidant properties as determined by FC and DPPH assays of the studied tea infusion increased in the order flavoured black tea < control black tea < newly flavoured black tea. Sensory evaluation analysis showed that the newly developed flavoured teas were well accepted by the respondents. Lastly a survey was conducted to see the effect of Ginger Tea on blood sugar levels on diabetics. It was observed that in 43% of the subjects decline in blood sugar level was remarkable while the others had a moderate change in their blood sugar level. Thus, the flavoured tea infusion would also provide the human diet with some source of antioxidants. Moreover, it indicates there is a wide scope of further research by incorporation of new fruit flavours in black tea.

Keywords: Flavoured Teas, Newly Developed Tea, Antioxidant Properties, Polyphenol Content, DPPH

Introduction

Tea contains numerous bioactive components like Catechins, Theaflavins, Thearubigins, Flavonols, Flavonol Glycosirdes, Methyl Xanthines, Primeverosides, Chlorophylls, volatile compounds, fluorides, phytoestrogens, vitamin C[12].

Tea has been historically promoted for having a variety of positive health benefits. Recent human studies suggest that green tea may help reduce the risk of cardiovascular disease and some forms of cancer, promote oral health, reduce blood pressure, help with weight control, improve antibacterial and antivirasic activity, provide protection from solar ultraviolet light[7], increase bone mineral density, and have anti-fibrotic properties, and neuroprotective power[1]. Additional research is needed to fully understand its contributions to human health, and advise its regular consumption in Western diets[1].

Evidence show there is a positive a relationship between tea consumption and tea polyphenols in the prevention of Cancer and Cardiovascular disease[1].

The important conventional teas are Black tea, Green Tea, Yellow Tea, Red Tea, Dark Tea and White Tea. A number of flavoured Black tea such as Ginger Tea, Cardamom Tea, Lemon Tea, Strawberry and Mango Tea, Tulsi Tea, etc are also available[10]. Flavoured tea is prepared by using additional flavor natural or synthetic[16]. The major types of flavoured black tea focused on are Ginger tea, Cardamom tea, Lemon tea, Strawberry and Mango tea. These teas apart from imparting a twist in the normal taste of tea also provide with additional health benefits. Ginger contains oleoresin such as [6]-gingerol (*1-[42 -hydroxy-32 - methoxyphenyl]-5-hydroxy-3-decanone* ;), causes pungency and has pharmacological and physiological activities. Cardamom, common Indian spice is known for its delicious aroma, aphrodisiac properties and is also used to treat stomach aches[9]. The vitamin C content of Lemon tea helps in detoxification, cold and flu, preventing cancer and skin problems like acne[5]. Mango and Strawberry tea is known for its benefits like prevention of cardiovascular diseases and certain types of cancer, boosting the immune system, treating digestive problems as well as skin conditions like eczema. Since flavoured tea is becoming very popular new flavoured tea were developed which were Apple Ginger and Mausumbi Ginger tea. Apple and ginger both have appreciable health benefits; therefore their incorporation in tea can have beneficial effects on health. Mausumbi is rich in Vitamin C and ginger rich in gingerol has anti diabetic effects hence their combination is advantageous. Since, ginger is commonly added to tea for refreshment and it also has anti diabetic effects and since India is the diabetic capital of the World the impact of Ginger tea on blood sugar levels of diabetics was undertaken. For the above mentioned benefits teas incorporated with these flavours were studied. . For the above mentioned benefits teas incorporated with these flavours were studied. This is a novel study as no research on this has been done. Research related to other flavours have been carried out but those flavours are not of Indian taste thus research in relation to Indian flavours needs to be done thus, the topic was chosen.

Methodolology

Sample Collection

5 tea samples Ginger, Lemon, Strawberry and Mango and Cardamom tea were collected from a Kolkata market. For the preparation of the newly flavoured tea Apple, Ginger and Sweet Lime (Mausumbi) were bought from the local market.

Chemicals

Ascorbic acid, dilute sulphuric acid, DPPH (2,2-diphenyl-1-picrylhydrazyl), Folin Ciocalteau reagent, Gallic acid Indigo carmine, Methanol, Oxalic acid, Potassium iodate, Potassium iodide, Potassium permanganate, Sodium carbonate, Starch, Sulphuric acid (3M).

Instruments

Spectrophotometer (Hitachi model U2910), B.O.D. Incubator, Laminar air flow, Vortex, Autoclave, Hot air oven, Micro pipette from Tarsons, Weighing Balance from Dhona and Water bath.

Preparation of Tea Infusions

1 gram of each variety of tea was weighed in a beaker. 100 ml of freshly boiled water was added to each beaker and it was allowed to stand for 5 minutes. After infusion time, the teas were filtered using Whattman filter paper. They were cooled then analyzed. To prepare Apple Ginger tea 100 ml of water was boiled along with 5 gm of grated ginger it was poured in a container containing the control tea leaves and covered. Tea was cooled to 60°C and 25 gm of grated apple was added and covered again. After 2 minutes the tea was strained. Freshly prepared sugar syrup was added to it according to taste for sensory evaluation. Mausumbi Ginger tea was prepared in the same control only. 10ml of freshly squeezed out Mausumbi juice was added when tea cooled to 50°C.

Determination of total phenolic compounds[12]

Total phenolic compound was determined using Folin-Ciocalteu reagent.

Determination of radical scavenging activity[12]

Radical scavenging activity was determined using DPPH assay.

Determination of vitamin C content[6]

The vitamin C content was determined using redox titration.

Determination of tannin content[17]

Tannin content was determined by titrating with standard potassium permanganate.

Sensory Evaluation of Newly Developed Flavoured Black Tea[14]

Sensory evaluation of the newly developed flavoured tea in comparison to control black tea was carried out using the 9 point hedonic scale.

Effect of Ginger Tea on Blood Sugar Levels

The effect of ginger tea on blood sugar level was seen by conducting a survey on 30 local diabetic people of Kolkata. Initial blood sugar levels of the subjects were recorded. The subjects were administered with ginger tea on a daily basis for a period of 8 weeks. Their blood sugar levels were monitored and recorded at an interval of every 2 weeks during this period.

Statistical Analysis

All reported data are mean ± SD. Statistical significance was checked by Student's t-test one-way analysis and two-way analysis of variance (ANOVA) at 5% level of significance ($P < 0.05$).

Results and Discussion

Antioxidant Assay

Five commercially available black tea four flavoured, one standard (Control) were bought. Two new flavoured black tea (Apple Ginger and Mausumbi Ginger) were developed. These were tested in the laboratory to assess their benefits and to compare it with the standard black tea.

The antioxidant activity in the tea samples was analyzed using 4 methods. They included Total Phenolic content estimation, Radical scavenging activity using DPPH, Ascorbic acid assay and Tannin estimation.

Table 1: Table showing mean values with standard deviation for antioxidant activity of the different types of tea samples.

Samples	Antioxidant Assays			
	Total Phenolic Content (mg GAE/g dry weight of tea)	Radical Scavenging activity (%)	Ascorbic acid assay (µg/ml)	Tannin estimation (%)
	mean ± standard deviation	mean ± standard deviation	mean ± standard deviation	mean ± standard deviation
Control Black Tea	104.21 ± 2.813	10.183 ± 0.351	6.667 ± 0.451	0.703 ± 0.064
Lemon Tea	91.21 ± 1.946	6.37 ± 0.115	12.4 ± 0.557	0.657 ± 0.032
Cardamom Tea	91.21 ± 1.946	7.833 ± 0.351	7.633 ± 0.404	0.63 ± 0.087
Ginger Tea	85.21 ± 1.573	5.95 ± 0.265	14.367 ± 0.416	0.587 ± 0.023
Strawberry & Mango Tea	91.5 ± 2.625	6.487 ± 0.11	3.333 ± 0.451	0.66 ± 0.017
Apple Ginger Tea	114.75 ± 8.25	10.79 ± 0.185	10.567 ± 0.351	0.667 ± 0.031
Mausumbi Ginger Tea	120 ± 15.136	25.703 ± 0.204	14.5 ± 0.4	0.667 ± 0.015

Total Phenolic Content Estimation

It was found that the Phenolic content in the studied types of tea varied widely as can be seen from table 1. In the commercially bought flavoured black tea the Phenolic content was lower than the control black tea. This may be due to the fact that flavoured black teas undergo further processing in comparison to the control black tea which might be causing a loss in their Phenolic content. In case of the newly developed Apple Ginger tea and Mausumbi Ginger tea the Phenolic content was more than the control black tea. This may be because these teas were prepared freshly and there was no loss in their Phenolic content as they did not undergo any processing as was seen in case of the commercially flavoured black tea.

Radical Scavenging Activity

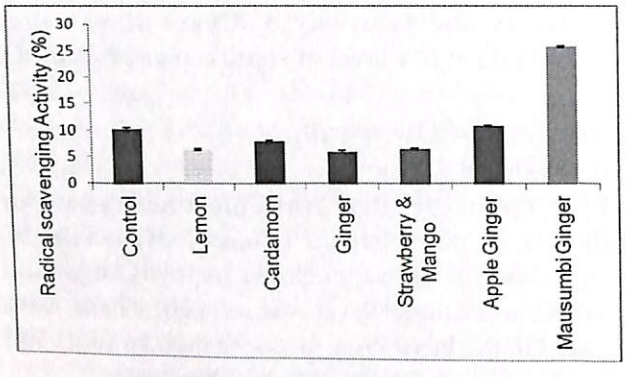

Fig 1: Radical Scavenging Activity (%) of different types of tea samples. The experiments were performed three times, and the mean values ± S.D. (error bars) have been shown in the lower panels.

The percentages of DPPH radical scavenging effect of each tea infusion are varied as can be seen from Fig 3 and Table 1. The control black tea exhibited a higher radical scavenging activity in comparison to the commercially bought flavoured black tea. Phenolic compounds are known to have antioxidative effects due to their abundance of hydroxyl groups having hydrogen- or electron-donating properties [13]. These hydroxyl groups interact with the DPPH free radicals As seen from the earlier result control black tea had a higher phenolic content thus they exhibited a greater radical scavenging activity in comparison to the commercially bought flavoured black tea. The newly prepared Apple Ginger and Mausumbi Ginger tea exhibited a higher radical scavenging activity than the control black tea and the commercially bought flavoured black tea since they have a higher Phenolic content as seen from the earlier result. This increase in phenolic content may be due to addition of the fruits (Apple and Mausumbi) as they naturally contain phenols[18].

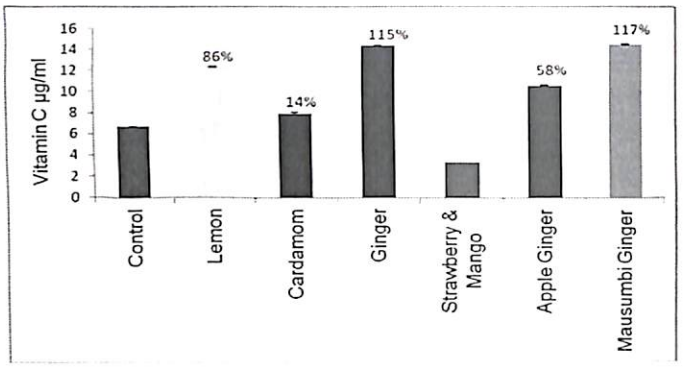

Fig 2: Vitamin C content in µg/ml of water extract of tea. The experiments were performed three times, and the mean values ± S.D. (error bars) have been shown in the lower panels (***, $p < 0.001$, *, $p < 0.05$)

The ascorbic acid content of each tea infusion varied as can be seen from table 1 and figure 2. Standard black tea has a low vitamin C content because of the presence of oxidase enzyme. This oxidase enzyme has a destructive effect on vitamin C. The flavoured black tea (Lemon, Ginger and Cardamom) and the newly flavoured black tea have greater vitamin C content since the flavours that have been added themselves contain vitamin C which thereby enhance the already present vitamin C in tea [8].

Tannin Estimation

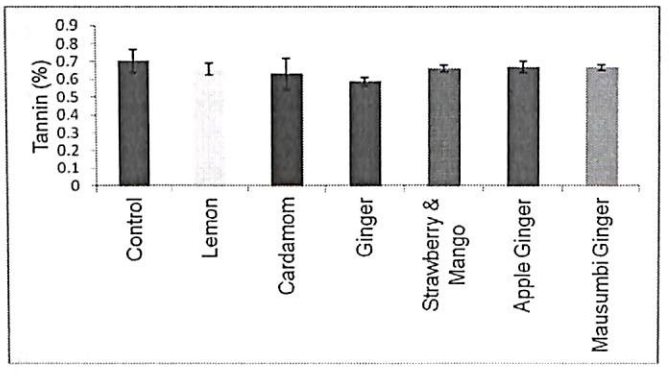

Fig 3: Tannin content in percent (%). *The experiments were performed three times, and the mean values ± S.D. (error bars) have been shown in the lower panels.*

The percentage of tannin in different tea samples was wide-ranging as can be seen from table 1 and figure 3. Tannins (commonly referred to as tannic acid) are water-soluble polyphenols that are present in many plant foods. They have been reported to be responsible for decreases in feed intake, growth rate, feed efficiency, net metabolizable energy, and protein digestibility in experimental animals.

Therefore, foods rich in tannins are considered to be of low nutritional value[3]. Our result is in support of previous studies which have reported that flavoured black tea have a tannin content slightly lower than that of standard black tea[17] thus, their consumption is better than the consumption of standard black tea.

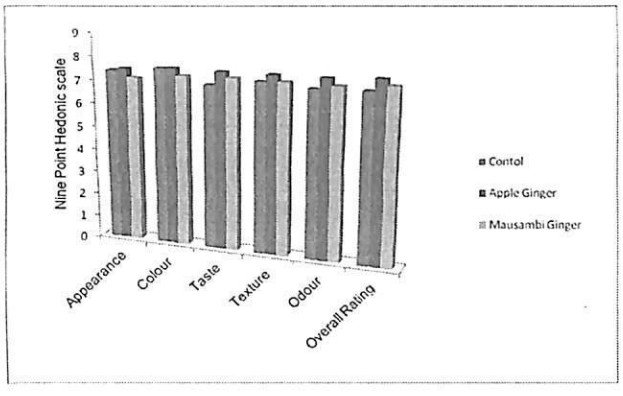

Fig 4: Sensory Evaluation of Newly developed Teas

Sensory evaluation of the newly prepared Apple Ginger tea and Mausumbi Ginger tea in comparison to control black tea was performed on the basis of quality parameters. Sensory score for appearance, colour, taste, texture, odour and overall acceptability of the Apple Ginger tea and Mausumbi Ginger tea by the trained panel are shown in Fig 4. The sensory evaluation for overall acceptability by semi trained panel showed that Apple Ginger tea and Mausumbi Ginger tea was liked by 77% and 74.3% of panelists respectively in comparison to control tea which was liked by 71.7%. In terms of taste,colour and appearance of the Apple Ginger and Mausumbi Ginger tea 75% and 71.3% of the panelist liked their appearance, 76.3% and 73.3% were in favour with their colour and 76% and 73% of the panelists confirmed that they liked the taste of the Apple Ginger tea and Mausumbi Ginger tea respectively.

Effect of Ginger tea in regulation of blood sugar levels in diabetics

A survey on 30 diabetics was conducted to see the effect of ginger tea on blood sugar level. The duration of the survey was 8 weeks. The effect of ginger tea varied among the subjects. An appreciable decline in blood sugar level was observed in 43% of the surveyed population. Whereas in the rest 57% only a slight decline in the blood sugar level was observed. Figure 5.7 shows an average trend of decline in sugar levels of the surveyed population.

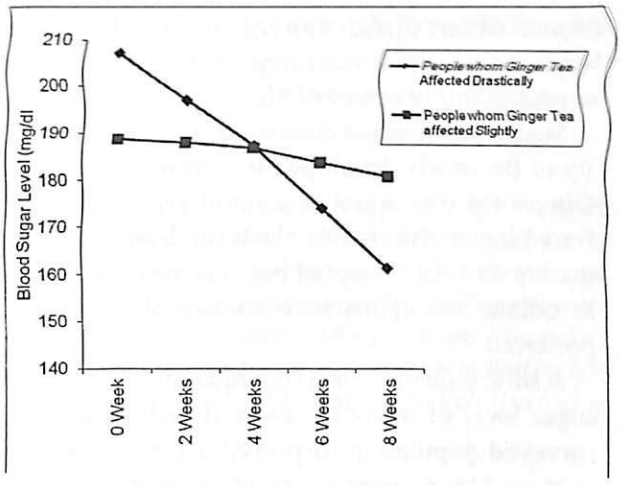

Fig 5: Average trend of decline of blood sugar level in diabetics of surveyed population.

Ginger tea did cause an appreciable decline in the blood sugar level of some subjects. This could be due to the positive effect of gingerols present in ginger which are known to assist in management of high sugar levels [11]. Researchers have also claimed that diabetics who consume ginger tea regularly can put off kidney damage to a great extent. Studies have shown that ginger contains high amount of zinc which has an important role in insulin secretion and production [4]. It is known that insulin is the hormone that regulates blood glucose level and diabetics often complain of low insulin production. A decrease in zinc level can affect insulin level leading to diabetic symptoms. Hence, regular consumption of ginger tea can provide the body with sufficient zinc which will in turn help in maintaining insulin production.

Conclusion

The present study suggests that the new natural flavours incorporated in the black tea namely Mausumbi Ginger and Apple Ginger exhibited higher antioxidant properties in comparison to commercially available flavoured black tea and control black tea. They were found to contain more Phenolic content and radical scavenging activity when compared to control black tea.

The vitamin C content of the commercially available flavoured black tea mainly Ginger tea, Lemon tea and Cardamom tea was found to be 86%, 115%, and 14% respectively more in comparison to control black tea. The newly flavoured Apple Ginger and Mausumbi Ginger tea showed evidence of 58% and 117 % more vitamin C content respectively when compared with control black tea. Tannin content was found to be more in case of control black tea which was in compliance to the previous study which had reported that flavoured black tea have

tannin content slightly lower than that of standard black tea thus their consumption is better than the consumption of standard black tea[17].

Sensory evaluation done to check the acceptability of the newly developed tea showed that Apple Ginger tea was widely accepted and people preferred it over the control black tea. Mausumbi ginger tea was also accepted but in some aspects such as colour and appearance control black tea was preferred.

A survey on the effect of ginger tea on the blood sugar level of diabetics showed that 43% of the surveyed population displayed a notable decline in their blood sugar level while in the others a moderate change in the blood sugar level was observed.

Evaluation of the antioxidant status of different types of commercially available and freshly prepared flavoured teas will promote research on the identification and quantification of active components of these teas that may help protect consumers against free radical damage and oxidative stress related diseases.

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Estimation of the Level of Trace Elements in Packaged Fruit Juices as Compared to Fresh Fruit Juices

Debanjali Jairam and Vipasha Chakravarty

ABSTRACT

Recent concerns about the elemental contamination of packaged fruit juice, prompted to design a study to analyse the elemental content of packaged fruit juice. A research was carried out to evaluate the concentration of heavy metals and trace elements in packaged fruit juice as well as in fresh fruit juice. Five fruit juices were selected from two well known manufacturers and bought from two supermarkets of Kolkata. The corresponding fresh fruits were selected from local markets. The trace elements content was evaluated by EDXRF (Energy Dispersive X-Ray Fluorescence) spectrometry after carbonization of the samples. Most of the fresh juice were high in metal concentration as compared to packaged ones. The data obtained was compared with the standard values of Indian Council of Medical Research.

Keywords: EDXRF, Trace Elements, Pelletizer, Fresh Fruit Juice, Commercial Fruit Juice.

Introduction

The food processing industry in India is a sunrise sector that has gained prominence in recent years. Availability of raw materials, changing lifestyles and relaxation in policies has given a considerable push to the industry's growth. Fruit juices are becoming an important part of the modern diet in many communities. It acts as a nutritious beverage and can play a significant part in a healthy diet. The ingredients of processed juices contain mainly water, sugar, preservatives, colour and fruits pulps[10].

Food packaging is an important part of food processing operations and food preservation. Packaging serves a number of different functions including preservation, containment, and convenience. The selection and development of a package depend on the nature of the food, the desired shelf life of the product, the storage conditions, and the cost[5].

Food chain contamination by heavy metals has become a burning issue in recent years because of their potential accumulation in biosystems through contaminated water, soil and air.[11] People may be exposed to potentially harmful chemical, physical and biological agents in air, food, water or soil. However, exposure does not result only from the presence of a harmful agent in the environment[4].

Iron, copper and zinc are essential elements because of their roles in biological samples, while lead is toxic even in trace amount. These elements can also be toxic when they are taken in excessively. Copper plays an important role as catalyst in the oxidation of organic compounds that are responsible for the stability and it is required in hemoglobin synthesis. Zinc is essential for many enzymes involved in several physiological functions, such as protein synthesis and energy metabolism. Lead is a highly toxic element that accumulates in biological systems and it leads to deficits in psychological functions such as intelligence and learning ability in humans.

Trace elements are chemical elements that are present in samples in very low concentration usually in the range of milligrams per kilogram (ppm). The term is also used to designate a number of chemical elements contained in soil, mineral, rocks, water and living organism[14]. Trace elements are taken up from the soil by plant and so they reach man directly through eating plant, or indirectly through meat or milk, they can also reach him through water and air[14].

It is very important to evaluate industrial fruit juices for consumer safety, as they are widely consumed throughout the world. Fruit juices are a highly appreciated, tasty food, and usually have exceptional nutritional qualities. However, they can be a potential source of toxic elements, some of them having an accumulative effect or leading to nutritional problems.

Methodology

Sample Collection

For the collection of packaged fruit juices a survey was conducted in the super markets of Kolkata. From two super markets More and C3, the packaged fruit juices were collected. Two different companies, named COMPANY-A and COMPANY-B

were selected. Five different fruit juices were collected from each company. Five types of juices namely Orange, Grapes, Pineapple, Guava and Apple juice. The respective fruits were collected from local market and juices made in home.

Sample Preparation

Fruit juice contains high amount of sugars and as well as little amount if protein, amylums, additives etc. For analyzing the metal content by EDXRF it is necessary to convert the samples in powdered form as it helps to make pellets from the powdered sample. Pellet formed samples are analysed by EDXRF. But fruit juice contains high amount of sugar and due to that it gets sticky and cannot be dried under freeze dryer. On the contrary the high content of the soluble solid substances that can be carbonized easily to form a solid sample will facilitate the preparation of pellets for X-Ray Fluorescence Spectrometry[7]. So the samples were carbonized under muffle furnace.

Pellet Preperation

10 ml of each juice was measured and placed into a 20 ml silicon cup, which has been constant at approx. 300°C before use, evaporated slowly until dry on a hot plate at e temperature of 150°-200°C. It was carbonized for 30 minutes at 300°C in a Muffle Furnace, and then allowed to cool in a dessicator for 30 minutes[11].

The carbonized sample is transferred into a large Agate Mortar Pestle and ground for 10 minutes. 120 mg of powdered sample and 30 mg of cellulose is added and ground together in an agate mortar for another 20 minutes[11]. Pellets were made by 150 mg of powdered sample by applying a high pressure of 200 kg/cm^2 in the Pelletizer for 20 minutes. A 13 mm die was used in the pelletizer for the pellet preparation. 3 identical pellets were made from each sample.

In the present study, the Xenemetrix EX- 3600 EDXRF Spectrometer has been used for elemental analysis. This consists of an X-Ray tube with a Rh anode as asource of X-Rays with a 50V, 1mA power supply, Si (Li) detector with a resolution of 143eV at 5.9keV. 10 sample turret enables mounting and analyzing 10 samples at a time. The inbuilt software nEXT carries out the quantitative analysis[6].

Statistical analysis of the data obtained was carried out using EXCEL 2007 data analysis pack. Mean Standard deviation and ANOVA was calculated for all the data.

Results and Discussion

Fruit juices were analysed by using EDXRF spectrometer. The elements were quantified using nEXT software.

Guava juice

The range of concentration in elements of Guava juice is as follows,

P- (Min) 22.5 mg/100 gm (Max) 260 mg/100 gm
S- (Min) 20 mg/100 gm (Max) 195 mg/100 gm
Cl- (Min) 128 mg/100 gm (Max) 1447 mg/100 gm
K- (Min) 619 mg/100 gm, (Max) 3029 mg/100 gm
Ca- (Min) 957 mg/100 gm, (Max) 377 mg/100 gm
Fe- (Min) 6 mg/100 gm (Max) 9 mg/100 gm

The concentration of these elements is presented in figure no.1

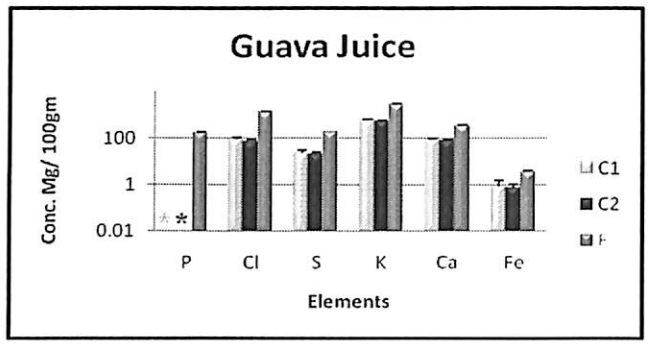

Fig 1: Concentration of different elements present in Guava juice

One of the interesting observations is that P is not detected in the packaged guava juice. There is excessively high amount of Potassium present in fresh guava juice, which is also exceeding the ICMR value. However the P content in fresh juice is within the RDA value and is safe for human consumption. K is present in higher amount among the other elements. All the elements are present in higher concentration in freshly available juice.

Orange juice

The range of concentration in elements of orange juice is as follows,

P- (Min) 39mg/100 gm, (Max) 184 mg/100 gm
S- (Min) 0, (Max) 44 mg/100 gm
Cl- (Min) 145 mg/100 gm, (Max) 482 mg/100 gm
K- (Min) 858 mg/100 gm, (Max) 2309 mg/100 gm
Ca- (Min) 100.36 mg/100 gm, (Max) 399 mg/100 gm
Fe- (Min) 5 mg/100 gm, (Max) 15 mg/100 gm

The concentration of these elements is presented in figure no.2

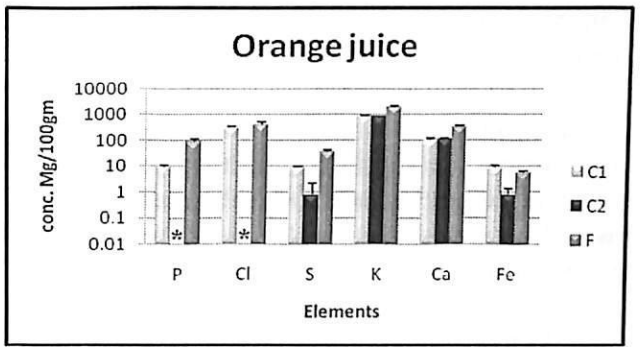

Fig 2: Concentration of different elements present in Orange juice

P and Cl are not detected in company 2. Most of the elements are higher in fresh juice than that of commercially available ones. K is present in highest concentration in packaged as well as in fresh as compared to other elements. Fe present in comparatively higher concentration in company 1 fruit juice. Ca also had shown an interesting peak than other elements. Fe is higher in company 1 fruit juice.

Pineapple

The range of concentration in elements of Pineapple juice is as follows,

P- (Min) 22 mg/100 gm, (Max) 126.56 mg/100 gm
S- (Min) 17 mg/100 gm, (Max) 40.5 mg/100 gm
Cl- (Min) 253.5 mg/100 gm, (Max) 306 mg/100 gm
K- (Min) 861 mg/100 gm, (Max) 1956 mg/100 gm
Ca- (Min) 160 mg/100 gm, (Max) 306 mg/100 gm
Mn- (Min) 8 mg/100 gm, (Max) 26 mg/100 gm

The concentration of these elements is presented in figure no.3

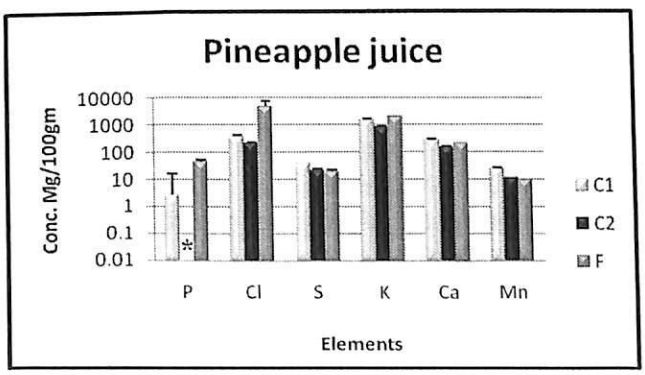

Fig 3: Concentration of different elements present in Pineapple juice

In Company 2 Ca and Mn are present in comparatively higher concentration. P is not detected in Pineapple juice of company 2. In company 1 and fresh P content is noticeably of higher concentration. S is present in quite higher amount in company 1. And in company 2 and fresh also shows significantly higher concentration. Like Guava and Orange, in pineapple K and Cl is present in much higher concentration.

Apple juice

The concentration range of elements in Apple juice is as follows,

S- (Min) 0, (Max) 194 mg/100 gm
Cl- (Min) 32 mg/100 gm, 209 mg/100 gm
K- (Min) 210 mg/100 gm, (Max) 1015 mg/100 gm
Ca- (Min) 33 mg/100 gm, (Max) 168 mg/100 gm
Fe- (Min) 5.1 mg/100 gm, (Max) 10 mg/100 gm

The concentration of these elements is presented in figure no.4

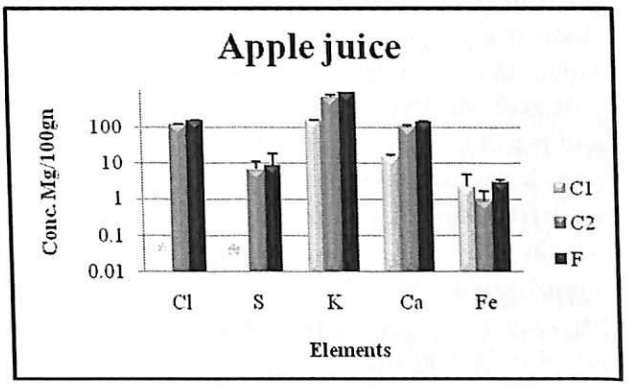

Fig 3: Concentration of different elements present in Apple juice

S is present in quite significant concentration in company 2 and fresh juice but it is not identified in company 1. Cl is not detected in company 1. Again there is much higher concentration of K in fresh, comparatively lower in companies than that of fresh but as compared to other elements it is present in much higher in concentration. Fe is present in both the company 1 and fresh juice. Ca also present in quite noticeable amount.

Grapes Juice

The concentration range in elements of Grapes juice is as follows,

P- (Min) 14.3 mg/100 gm, (Max) 209.3 mg/100 gm
S- (Min) 37 mg/100 gm, (Max) 134.08 mg/100 gm
Cl- (Min) 26 mg/100 gm, (Max) 483 mg/100 gm
K- (Min) 190.02 mg/100 gm, (Max) 908 mg/100 gm
Ca- (Min) 100.5 mg/100 gm, (Max) 2112 mg/100 gm
Fe- (Min) 12.16 mg/100 gm, (Max) 19 mg/100 gm

The concentration of these elements is presented in figure no.5

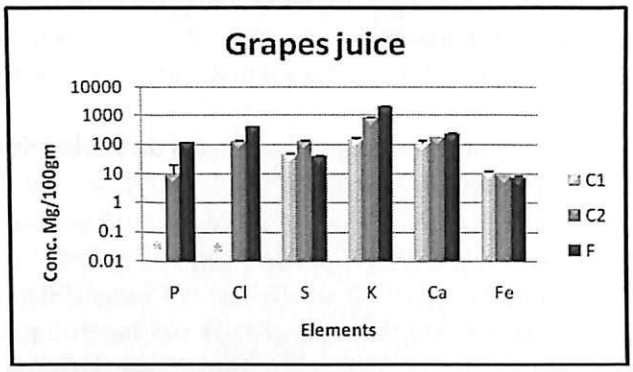

Fig 5: Concentration of different elements present in Grape juice

P and Cl are not present in Company 1. Like other juice, in grapes juice also K is present in high level. Apart from S and Fe all the elements are present in higher in concentration in fresh juice.

Results of ANOVA analysis in terms of f-value and p-value were calculated. In Guava the variations between the groups i.e., between C1, C2 and F are found to be statistically significant at $p<0.05$ for the elements such as P, S, K, Fe and non-significant for the Ca. In orange the variations between the groups i.e between C1, C2 and F are found to be statistically significant at $p<0.05$ for the elements such as P, S, K, Fe and non-significant for Ca. In Pineapple the variations between the groups i.e between C1, C2 and F are found to be statistically significant at $p<0.05$ for the elements such as P, S, Cl, K, Ca, Mn. In Apple the variations between the groups i.e between C1, C2 and F are found to be statistically significant at $p<0.05$ for the elements such as Cl, K, Ca, and non-significant for the elements such as S, Fe. In Grapes the variations between the groups i.e between C1, C2 and F are found to be statistically significant at $p<0.05$ for the elements such as P, S, Cl, K, Ca, Fe.

Here P means level of significance. The null hypothsis here is that the group means are all equal, and the alternative hypothesis is that they are not. A big F i.e the ratio between the variance between the groups and variance within the group, with a small p-value (level of significance), means that the null hypothesis is discredited, and we would assert that the means are significantly different, while a small F, with a big p-value indicates that they are not significantly different.

P value is associated with a test statistic. It is the probability, if the test statistic really were distributed as it would be under the null hypothesis, of observing a test statistic the one actually observed. The smaller the P value, the more strongly the test rejects the null hypothesis, that is, the hypothesis being tested. A p-value of .05 or less rejects the null hypothesis at the 5% level that is, the statistical assumptions used imply that only 5% of the time would the supposed statistical process produce a finding this extreme if the null hypothesis were true. A positive is a significant result, i.e. the p-value is less than the cut off value, normally 0.05. A cut off of 0.05 means there is a 5% chance of making the wrong decision.

A parallel study was done in Brazil, where they found that metal contents in fruit juice depend upon the soil composition and fertilizers used. They also observed during industrialized juice production there is loss of trace elements[3]. A study was done in Washington on the effects of NPK (Nitrogen, Potassium and Phosphorus) fertilizers on the composition of orange juice. There they found that application of this fertilizer increased the concentration of potassium, phosphorus and nitrogen in fruit juice. The use of manure as the only fertilizer greatly increased the concentration of potassium in juice. [15] Use of pesticides also may affect the composition of fruit juice.

Phosphorus

A trend has been followed in the results. Phosphorus is present in all the fresh juice. But it is either absent in company 1 or 2 or in both (Apple). Deficiency of phosphorous may result in stunted growth, poor quality of bones and teeth, arthritis, rickets and tooth decay; it's also causes lack of appetite and weight loss. Phosphorous regulate breathing, mental and physical fatigue, and nervous disorders may also occur.

Chlorine

The amount of chloride in soils varies according to the distance from the sea. The average in top soils is about 10 ppm. Plants contain various amount of chlorine.

In the present study the concentration of chlorine is quite high in all the fresh juice. In case of company 1 Apple and Grapes juice and company 2 Orange juice Cl is not detected. Effects of chlorine on human health depend on how the amount of chlorine that is present, and the length and frequency of exposure. The effect of chlorine also depends on the health of a person or condition of the environment when exposure occurs[7].

Sulphur

All living things need sulphur. It is especially important for humans because it is part of the amino

acid methionine, which is an absolute dietary requirement for us. In all the juice S is present in quite noticeable amount. But none of them have exceeded the ICMR value. In company 1 Apple juice it not detected. In all the juice it is present in higher concentration in freshly available juice. But in Company 1 Pineapple juice it is present in higher concentration as compared to company 2 and fresh juice and also in company 2 grapes juice it is present in higher concentration than that of other two.

Potassium

The RDA for Potassium is 4700mg/day (for 18 yrs and above). In the present study in most of the samples the concentration of potassium is much higher in fresh juice as compared to the commercially available ones. Even among all the 13 elements it shows the highest peak in most of the cases. The total K content of soils frequently exceeds 20,000 ppm (parts per million). Nearly all of this is in the structural component of soil minerals and is not available for plant growth. Potassium helps in the building of protein, photosynthesis, fruit quality and reduction of diseases. Potassium is supplied to plants by soil minerals, organic materials, and fertilizer.

Manganese

Mn is an essential element for both plants and animals. It plays an important role as an activator and enzymes constituent. Mn comprises 0.1% of the earth crust[1]. It is also plays a role in protein, carbohydrate and fat production[2].

In the present research it has been seen that Mn is present in all the juice irrespective of fresh or commercial juice in lower concentration, but in case of pineapple juice it was found in higher concentration (9.77mg/100gm). Raw pineapple is an excellent source of manganese (76% Daily Value (DV) in a one US cup serving)[15].

It is more frequently of toxicological concern because over exposure to the metal can lead to progressive, permanent, neurodegenerative damage, resulting in syndrome similar to idiopathic Parkinson's disease[12].

Iron

In this present study it was observed that iron is present more or less in all type of juice except for Pineapple juice. In fresh Guava juice iron is present in high concentration. In case of orange and apple juice iron is present in higher concentration in company 1 and fresh juice but comparatively lower in concentration in company 1. *In grapes juice in company 1, company 2 and in fresh juice the concentration of iron found approximately equivalent.*

Conclusion

Fruit juice is becoming an important part of modern diet as it is easy to consume, they contain lots of important nutrients in it, and can play a significant part in healthy diet. It is very important to evaluate industrialized fruit juice for consumer safety as it is consumed throughout the world[9]. Metal contents such as copper, iron, zinc, manganese etc in fruit juice and beverages are important due to their essential or toxic effects on human metabolism, human health and contamination. The main sources of the elements in such samples may be water, fruit, soil, manufacturing process, containers and environmental contamination due to fertilizers, pesticides, raw materials, etc[9].

The objectives of this study was to find out the level of trace elements in packaged juice and freshly available fruit juice and most importantly to find out whether the trace elements level is exceeding the toxicity level or not.

In the present study five different types of packaged juice from two different companies were taken and they were compared with the same of freshly available juice. Surprisingly in the present study it is observed that the trace and heavy metal content in fresh fruit juice is much higher than that of commercial fruit juice. The elemental content of packaged juice has shown some variation in almost all the elements with respect to fresh juice. The analysis of variance (ANOVA) indicated statistical significant differences in each metal level in the five fruit juice categories. A significant decrease has been seen in all the essential elements such as K, P, S, Cl, Mn, Fe and Zn may be during processing of the juice. Higher concentration of the elements has been observed in the fresh juice may be because of the fertilizers, soil and environmental pollution. There is insufficient report about packaged and fresh juice for the safety of human consumption in relation to the elemental concentration and toxicity. It needs further research and scientific progress in this regard.

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Immobilization of Tannase and its Effect on Tea

Chitrarpita Saha And Sonali Ghosh

ABSTRACT

Tea is one of the most commonly consumed beverages with lots of benefits. But it has certain disadvantages due to its high content of tannin. Previous research showed that those problems can be overcome by various processes including enzymatic treatment. The present study was aimed to enhance the quality of tea using tannase. An extracellular tannase was extracted from the agricultural waste (red gram husk) using Aspergillus niger *by solid state fermentation. The crude enzyme was purified using ammonium sulphate precipitation followed by DEAE cellulose chromatography which leads to 9.21 fold of purification and 28% recovery. The purified enzyme with an activity of 193.1 U/ml was used in the treatment of tea at room temperature for 2 hrs. Tannase treatment resulted in approximately 56% degradation of tannin, 85% increase in total polyphenol, 46% increase in total sugar level and 128% increase in anti-oxidant activity. Protein-tannin aggregation, which negatively affects the quality of tea, decreases about 58% and tea-cream formation also reduces by 85% after tannase treatment. Through sensory evaluation, the acceptability of the tannase treated tea is also established. The results were satisfactory and encouraging for further investigation.*

Keywords : Tea, Tannin, Tannase, *Aspergillus Niger,* Red Gram Husk, DPPH, Folin-ciocalteu, Polyphenols, Gallate Catechines

Introduction

Tea (*Camellia sinensis*) is the second most widely consumed non-alcoholic beverage, rich in polyphenolic compounds including epigallocatechin gallate (EGCG), EGC, epicatechin gallate (ECG) and EC. They possess strong antioxidant properties and have also shown antimutagenic and anticarcinogenic properties along with their role in preventing cardiovascular diseases[17]. The main advantage of tea lies in the fact that it is a completely natural product, without any added flavourings, colours or preservatives. Likewise, when drunk without adding any sugar, honey or milk, tea has no calories and simultaneously serves as a crucial component for maintaining the balance of body liquids[1].

A tannin is an astringent, bitter plant polyphenolic compound that binds to and precipitates proteins and various other organic compounds including amino acids and alkaloids. Nutritionists define tannins as anti-nutrients of plant origin because they can precipitate proteins, inhibit the action of digestive enzymes, and decrease utilization or bio-availability of vitamins and minerals. The presence of tannins in foods can be highly undesirable as they contribute to astringent or bitter tastes in certain beverages[2].

During production of tea beverages particularly for those ready-to-drink tea products, hot and clear tea infusion tends to produce noticeably turbid precipitates, namely tea- cream, upon cooling[13]. This phenomenon worsens as storage period extends, which will lower appeal for consumers. Tea-cream is mainly a complex mixture of polyphenols. The amount of tea cream formed in tea infusion depends on its chemical composition; gallated catechins have stronger creaming ability than un-gallated ones[0].

In enzymology, a tannase is an enzyme that catalyzes the chemical reaction digallate + $H_2O \rightleftharpoons$ 2 gallate

Tannase (tannin acyl hydrolase) is an inducible, extra cellular hydrolase enzyme that catalyzes the breakdown of ester and depside bonds present in hydrolysable tannins or gallic acid esters, liberating glucose and gallic acid[3].

Many clinical studies and animal models have shown that despite the proven antioxidant capacity of tea polyphenols, these compounds, especially the polymers, esters and glycosides, are abundant but are not always absorbed by oral administration. However, the functional effect of these compounds depends not only on the amount ingested but also on its bioavailability[14]. Therefore, it would be worthwhile to investigate the enzymatic hydrolysis of polyphenols present in tea in order to make these compounds available, which are having great importance[3].

In India where the economy is largely depend on agriculture and farming practice is intensive, accumulation of agricultural residues is a serious problem. The presence of tannins and their derivatives in agro-residues is a major hurdle in their utilization as feed material. Solid-state fermentation technology using non-pathogenic micro-organisms that can produce hydrolytic enzymes such as tannase would be advantageous for the proper utilization of these residues.

Methodology

Black and green teas were purchased from local market. Red gram husks were procured from Dalpatti, Barabazar in Kolkata. *Aspergillus niger* was collected from college laboratory.

Pre-treatment[8]

Red gram husk were sun-dried, pulverized and stored in air-tight containers for further use. A strain of *Aspergillus niger* was used for the study. Spores were raised on potato dextrose agar slants sporulation medium.

Fermentation and Extraction[8]

Five gram red gram husk was moistened with 10 ml of salt solution. The contents were sterilized by autoclaving. The solid substrate was inoculated with 1ml of *Aspergillus niger* spore inoculums and incubated at 37°C for 72 hours.

Tannase was extracted from the fermented substrate by adding buffer, and PMSF crushed with mortar and pestle in cold. After centrifugation and filtration, filtrate was stored for estimation of tannase activity.

Tannase Activity Assay[3]

Tannase activity was measured based on the formation of chromagen between gallic acid (released by the action of tannase on methyl gallate) and rhodanine. A standard curve was prepared using gallic acid. The enzyme reaction mixture was prepared by the addition of methyl gallate, citrate buffer and crude enzyme. Methanolic rhodanine and potassium hydroxide were also added. The pink colour developed was read at 520nm.

Protein Assay Of Tannase[3]

Standard protein prepared containing a range of 0.2 to 1 mg/ml BSA. Test sample was prepared by 40 times dilution and by adding Lowry reagent and Folin-Ciocalteu reagent to it. Absorbance was measured at 660nm spectrophotometrically.

Purification Of Tannase[7, 12]

Purification of tannase was carried out by 0-80% of ammonium sulphate precipitation and DEAE-cellulose column chromatography. The protein bounded to the column was eluted by linear gradient of NaCl 0.1M-0.7M in acetate buffer. The eluted fractions were collected and absorbances of the fractions were measured. The major peak fractions were then assayed for tannase activity. Only the fractions possessing tannase activity were pooled.

Tea Preparation and Treatment[10]

5 gm of each type of tea is mixed with 100 ml boiling water, incubated at 85°C for 20 mins in a water bath. The tea infusions obtained were filtered and to 1 ml of filtrate 100 µl of tannase (193U/ml) was added and incubated in 37°C for 2 hrs.

Tannin Assay[10]

Tannin assay was done using BSA, acetate buffer, Sodium dodecyl sulphate- triethanolamine buffer and ferric chloride. Standard curve was prepared with tannic acid.

Measurement of Total Sugar[10]

Glucose kit was used for the estimation of sugar level. Absorbance was measured at 500 nm.

Measurement of Total Phenolics[10]

Folin's reagent and sodium carbonate were added to the test sample and the absorbance measured at 765 nm. Gallic acid was used as standard.

Evaluation Of Tea-Cream Formation[6]

Precipitate resulted from the centrifugation of control and treated tea, was collected and weighed after being dried. The tea cream was expressed as weight of precipitate obtained per 100 ml of tea infusion.

Evaluation of Radical-Scavenging Activity[4, 10]

Radical scavenging activity was assayed using the 2, 2-diphenyl-1-picrylhydrazyl (DPPH) assay. The results were expressed as the percentage of reduction (inhibition) of the DPPH according to expression $(A_0-A_t)/A_0 \times 100$, where A_0 is the initial absorbance and at is the absorbance at increasing time t.

Evaluation Of Protein-Tannin Aggregation[5]

Bovine serum albumin (BSA), Coomassie blue, sodium dodecyl sulphate-triethanolamine buffer and isopropanol were used in the estimation of protein-tannin aggregation. The absorbance was then measured at 590 nm.

Sensory Evaluation[11]

The organoleptic evaluation of controlled and test sample of both black and green tea was performed for assessing the quality of tea by panel of 30 semi-trained members using 9-point hedonic scale.

Statistical Analysis[4]

All data are presented as the mean ± SD of three independent tests. The t test was used to evaluate the difference between treated samples and controls.

Results and Discussion

After purification of the crude enzyme, 9.21 fold of purification was achieved with a yield of 28%. The fraction showing highest activity of 193.1U/ml was used for removal of tannin from tea.

Table 1: Purification of tannase extracted from *Aspergillus niger* at each step

Purification steps	Volume (ml)	Protein (mg/ml)	Activity (U/ml)	Total Protein (mg)	Total Activity (U)	Specific Activity (U/mg)	Purification (fold)	Yield (%)
Crude extract	30	3.6	46.3	108	1389	12.86	1	100
Ammonium sulphate precipitation	6	2.12	96.5	12.7	579	45.5	3.54	73.4
DEAE-C	2	1.63	193.1	3.26	386.2	118.5	9.21	28

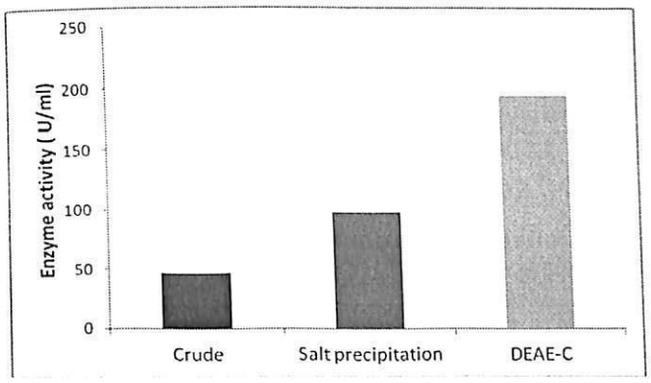

Fig 1: Enzyme activities in different steps of purification

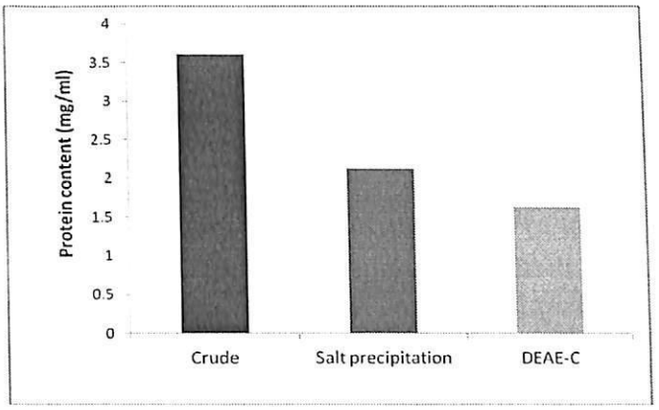

Fig 2: Protein content in different steps of purification

From the graphical representation of enzyme activity (Fig 1) and protein content (Fig 2) at different steps of purification it can be seen that enzyme activity gradually increases and protein content gradually decreases which determines a successful purification as the process progresses. This result is in support of previous studies[7].

ESTIMATION OF TANNIN CONTENT

Tannin content of both black and green tea increased in case of control samples while incubated. But tannin content decreased significantly ($p < 0.001$) with time in treated samples. After 2hours the reduction (55% for black tea, 56% for green tea) is much higher than after 1hr (38% for black tea, 26% for green tea). This indicates that tannin reduction efficiency depends on the incubation period where the enzyme gets to act on the substrate and break it[16]. This may be due to the breakdown of tannin by tannase into Gallic acid and tannin content reduces[5].

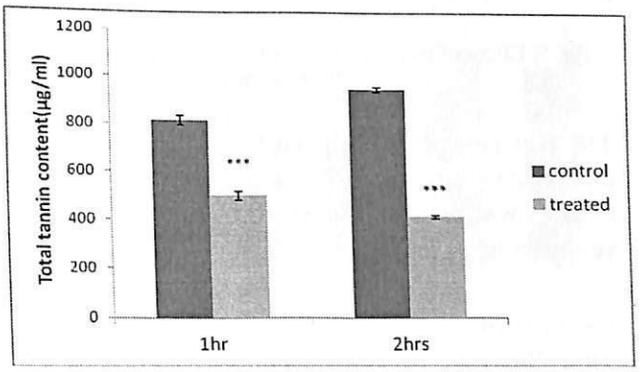

Fig 3: Effect of tannase (193.1U/ml) on tannin degradation at different time in black tea.

The experiments were performed three times, and the mean values ± S.D. (error bars) have been shown in the lower panels (***, $p < 0.001$ versus control tea).

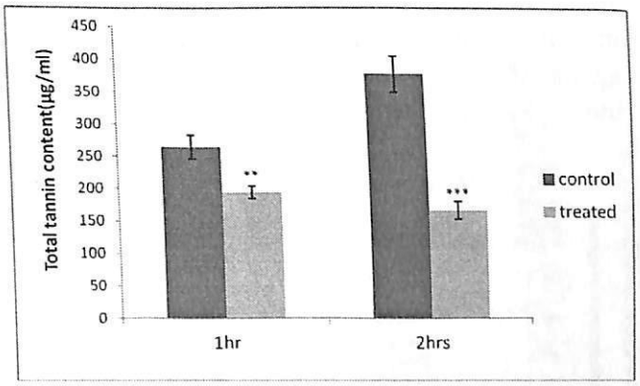

Fig 4: Effect of tannase (193.1U/ml) on tannin degradation at different time in green tea.

The experiments were performed three times, and the mean values ± S.D. (error bars) have been shown in the lower panels (***, $p < 0.001$ and **, $p < 0.01$ versus control tea).

Total Sugar

The total sugar content was increased significantly ($p < 0.001$ for black tea and $p < 0.01$ for green tea) to 46% and 44% (fig 5) in black and green tea respectively. Hydrolysis of tannins yields glucose and

gallic acid. Therefore increase in the sugar level of tea supports tannin degradation. The result is in support of previous studies where sugar content in fruit juice increases using tannase[10].

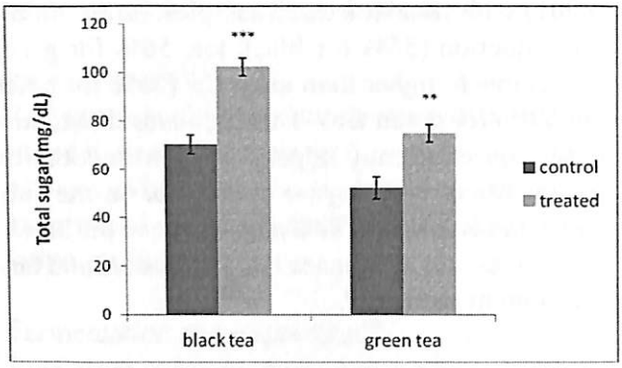

Fig 5: Effect of tannase on the total sugar content of black and green tea

The experiments were performed three times, and the mean values ± S.D. (error bars) have been shown in the lower panels (***, $p < 0.001$ and **, $p < 0.01$ versus control tea).

Total Phenol

After 2hrs incubation the phenolic content of both black and green tea increased significantly ($p < 0.001$ for black tea and $p < 0.05$ for green tea). This indicated that the purified tannase acted on the available tannins in the tea and hydrolyzed it to gallic acid[15]. Thereby there was an increase in the total phenol levels (Fig 6). Gallic acid seems to have antifungal and anti-viral properties. Gallic acid acts as an antioxidant and helps to protect human cells against oxidative damage[10]. So this result contributes to the enhancement of quality of tea.

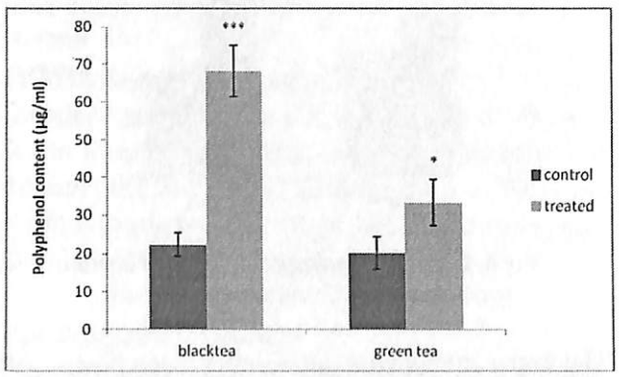

Figure 6 Effect of tannase on the total phenol content of black and green tea.

The experiments were performed three times, and the mean values ± S.D. (error bars) have been shown in the lower panels (***, $p < 0.001$ and *, $p < 0.05$ versus control tea).

Tea Cream Formation

Tea infusions were treated with tannase against control. The results showed that tannase could carry out significant ($p < 0.001$) reduction in cream formation up to 85% in black tea and 70% in green tea (Fig 7). The lowering of tea cream formation in enzyme treated tea infusion on refrigeration could be due to degallation of gallated catechines and other gallaeted polyphenols which prevent their interaction with protein[9, 6].

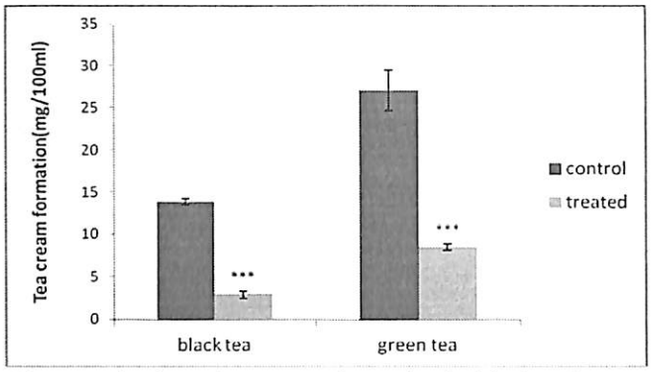

Fig 7: Evaluation of tea cream formation in black and green tea after tannase treatment

The experiments were performed three times, and the mean values ± S.D. (error bars) have been shown in the lower panels (***, $p < 0.001$ versus control tea).

Anti-oxidant Activity

Black tea and green tea have approximate 128% and 125% more free radical scavenging activity respectively when compared with control tea sample (Fig 8) which shows that tannase treatment can significantly($p < 0.01$) increase the anti-oxidant activity of both black and green tea. Similarly Lu and Chen reported an increase in radical scavenging activity of bio-transformed tea in previous research [4]. In the present study a trend of increasing radical-scavenging capacity in tannase treated tea samples was observed due to an increase in epigallocatechines and gallic acid contents. Similar study reported that higher antioxidant activity was observed in the compounds whose structures were having large number of hydroxyl groups [10].

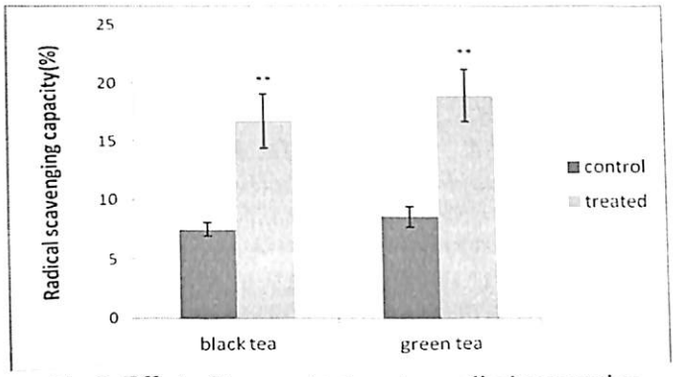

Fig 8: Effect of tannase treatment on radical scavenging activity of black and green tea

The experiments were performed three times, and the mean values ± S.D. (error bars) have been shown in the lower panels (**, $p < 0.01$ versus control tea).

Protein-Tannin Aggregation

It was observed that protein tannin aggregation rate is much lower in tannase treated tea when compared with control tea sample. The formation of complex between protein and tannin as well as the amount of protein present in that complex reduced significantly ($p < 0.001$) when tannase treatment applied (Fig 9). There was 54% reduction for black tea and 58% reduction for green tea in treated samples when compared with control. This result supports previous research which explains that reduction in protein-tannin aggregation is probably because the catechines in the treated one exists mostly in the form of EGC and EC instead of galleted catechines EGCG and ECG. The way tannin binds with protein is that the hydrogen atom in the hydroxyl group of tannin forms hydrogen bonding with the oygen atom in the carbonyl groups of protein. Galleted catechines do offer more hydroxyl groups for hydrogen bonding[5].

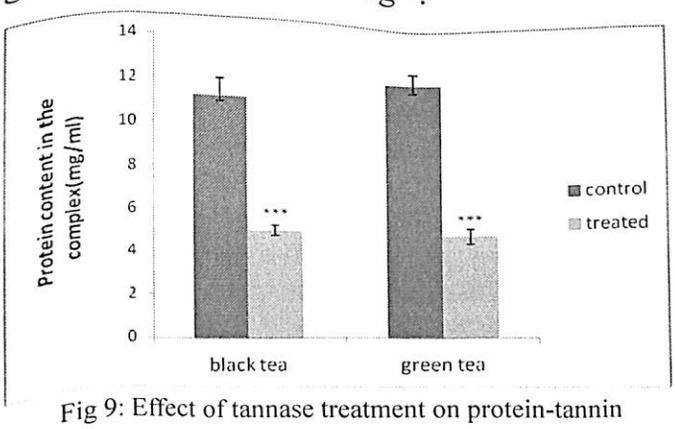

Fig 9: Effect of tannase treatment on protein-tannin aggregation

The experiments were performed three times, and the mean values ± S.D. (error bars) have been shown in the lower panels (***, $p < 0.001$ versus control tea).

Sensory Evaluation

Sensory evaluation of both black and green tea, before and after treatment was performed on the basis of the quality parameters[11]. Sensory score for appearance, colour, taste, odour, and overall acceptability of the tea treated with purified tannase protein by the trained panel are shown in Fig 10 and Fig 11. In all the aspects treated teas are preferred by the panellists for both black and green tea. So the acceptability of the tannase treated tea has been established.

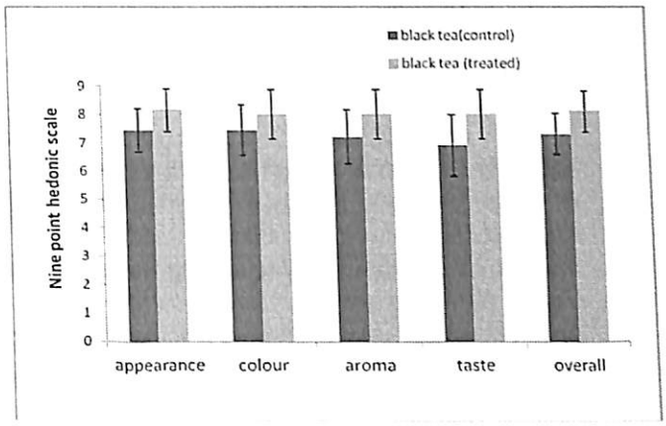

Fig 10: Sensory evaluation of control and treated black tea.

Error bars indicate standard deviation from triplicate determination.

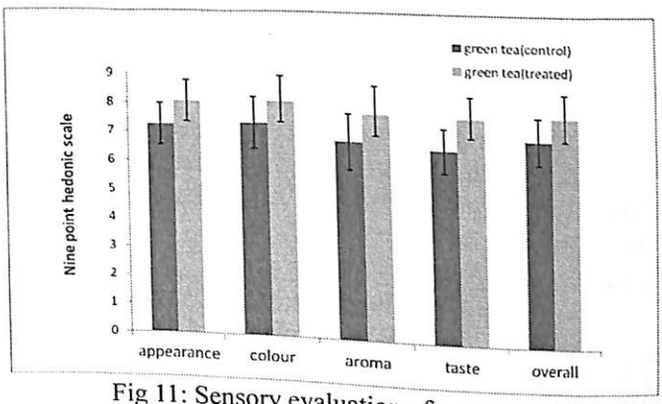

Fig 11: Sensory evaluation of control and treated green tea.

Error bars indicate standard deviation from triplicate determination.

Conclusion

After completion of the present study it can be concluded that there is clearly much scope for the industrially important enzyme tannase in enhancing the quality of tannin rich beverage and food materials. However due to insufficient knowledge about the enzyme, the difficulties in establishing cost-effective scaling up and downstream processing protocols in the large-scale application of tannase is currently still limited. It will be

exciting to witness the future developments in basic research as well as biotechnological applications of this versatile microbial enzyme.

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A Study on the Fortification of Whole Wheat Flour using Mushrooms Enriched with Vitamin D through Exposure to Sunlight

Khushboo Agarwala and Jincy Abraham

ABSTARCT

Mushrooms when exposed to sunlight could be a potential source of Vitamin D majorly benefiting the vegetarian group. A fortified product was prepared using sun exposed mushrooms as a source of Vitamin D to reduce the incidence of this micronutrient deficiency. The results obtained showed that fortification of whole wheat flour with Vitamin D enriched mushrooms could be carried out by a simple technique i.e. exposing mushrooms to sunlight to increase the vitamin content. Results obtained showed that mushrooms when exposed to sunlight for 7-9 hours showed maximum Vitamin D content as compared to non exposed mushrooms. The Vitamin D content in mushroom increased from 2480IU to 69680IU on exposing to sunlight. There was a change in the organoleptic properties and the vitamin D content was seen to decrease on over-exposure i.e., more than 9 hours. Paratha was the product developed which was fortified with Vitamin D enriched mushrooms. The difference in the levels of calcium and phosphorus in the fresh mushrooms, sun exposed mushrooms and the product developed was observed. The levels were seen to decrease in the developed product which could be due to the interaction with other nutrients or maybe due to its heat instability properties.

Keywords- Mushrooms, Sunlight, Time Exposure, Vitamin D

Introduction

From a public health viewpoint, micronutrient malnutrition is a concern not just because large numbers of people are affected, but also because micronutrient malnutrition, being a risk factor for many diseases, can contribute to high rates of morbidity and even mortality. It has been estimated that micronutrient deficiencies account for about 7.3% of the global burden of diseases, with iron and vitamin A and vitamin D deficiency ranking among the fifteen leading causes of the global disease burden[6].

Vitamin D, the fat soluble vitamin is one of the most important regulators of calcium and phosphorus homeostasis. It also plays many roles in cell differentiation and in the secretion and metabolism of hormones, including parathyroid hormone and insulin. Vitamin D (calciferol) is synthesized in the skin of most animals, including humans, from its precursor, 7-dehydrocholesterol, by the action of sunlight. This produces a naturally-occurring form of the vitamin known as vitamin D_3. Vitamin D can also be obtained from the diet, either as vitamin D_3 (cholecalciferol) or as a closely related molecule of plant origin known as vitamin D_2 (ergosterol). Since both forms are metabolized by humans in much the same way, from a nutritional perspective, vitamin D_3 and vitamin D_2 can be considered to be equivalent[10].

Severe vitamin D deficiency produces the bone disease called rickets in infants and children, and osteomalacia in adults, conditions which are characterized by the failure of the organic matrix of bone to calcify[2]. Several studies have shown that the effects of poor vitamin D status are exacerbated by low calcium intakes. This has been demonstrated in adults from India[3] and in children from Nigeria[7].

The existence of rickets in infants and children, and a high fracture risk among the elderly population, would suggest that vitamin D deficiency is a public health problem[9].

The global prevalence of vitamin D deficiency is uncertain, but it is likely to be fairly common worldwide, and especially among infants and young children, the elderly and those living at high latitudes where daylight hours are limited. People living in the far northerly latitudes, whose exposure to ultraviolet light is low especially during the winter months, are at high risk for vitamin D deficiencies[4].

Milk and other dairy products, including dried milk powder and evaporated milk, are often fortified with vitamin D. Many countries also fortify margarines with this vitamin. Low exposure to sunlight is a risk factor for vitamin D deficiency and can be a problem among those who live in the more northerly or southerly latitudes where UV radiation levels are lower during the winter months, and among women who, for cultural reasons, spend a large proportion of their time indoors or covered with clothing. In such situations, vitamin D fortification of milk and margarine have been found to be useful strategies for increasing intakes; the goal is to supply up to 200 IU/day in the total diet[8].

Wild mushrooms are ancient foods that have been consumed throughout history. Mushrooms are referred to as the "food that feeds the food", the

great recycler that provides the essential nutrients that are needed by plants and animals. Wild mushroom varieties are not easily harvested and are perishable so drying helps make them more readily available. Dried mushrooms have several advantages over fresh ones. Dried mushrooms can be stored for longer periods of time; they are easily reconstituted and can be used in place of fresh mushrooms in most recipes. Mushrooms are one of those rare foods that even better dried because the drying process intensifies their flavor and makes them more economical for everyday use. Mushrooms can be termed as a protein substitute depending on the variety. They contain 2 to 4% protein and all the essential amino acids, making their protein complete. Mushrooms are Vitamin D rich source and can make a complete protein among the vegetarian category and could be an ideal substitute to meat[1, 5]. Research at Tufts University in Massachusetts proposed that eating mushrooms may help fight off infections and viruses by boosting the body's natural immune system. Mushrooms provide the best non-animal source of vitamin D and are a rich source of potassium and phosphorous. About 5 raw button mushrooms for instance, contain 370 mg. of potassium and 104 mg. phosphorous. Most cultivated dried mushrooms contain vitamins C and K, and some vitamin E. They also have many of the B vitamins, including the B-complex vitamins - riboflavin, niacin and pantothenic acid[5, 6].

Whole wheat flour forms the stable diet for most of the Indians. Whole wheat flour is rich in dietary fibre, starch, fat, antioxidant nutrients, minerals, vitamin, lignans, and phenolic compounds that have been linked to the reduced risk of obesity, insulin resistance, dyslipidemia, Type 2 Diabetes Mellitus, heart diseases, hypertension, cancer, and other chronic diseases.

Materials and Methods

High Pressure Liquid Chromatography (HPLC), B.O.D. Incubator, Laminar air flow, Centrifuge from Remi, Autoclave, Hot air oven, Muffle Furnace, Micro pipette from Tarsons, Weighing Balance from Dhona and Water bath. Beaker, pipette, test tubes, conical flask, funnel, glass rod, Petri dishes, glass beads, sintered funnel and micro pipette tips from Tarsons, Whattman filter paper were used.

Agaricus bisporous commonly known as white button mushrooms was collected from the local Beck Began market in Park Circus, Kolkata. The packet consisted about 8-10 mushrooms (200-250 gms) and costed Rs 35 per packet. The whole wheat flour was collected from the local flour mill. A total of 2kgs were required, which were bought at once and costed Rs 40 a kg. The samples were all washed, dried and then cut into thin slices. They were spread properly into big steel plates and dried in two batches for 7 hours and the other was left for another 2 hours and dried for a total of 9 hours. From the 9 hour batch approx 100gms were taken and then dried further for 4-5 hours but was not acceptable as it was over exposed and looked like it was burnt and had a very coarse and crumbly texture with a distinct odour. The best time of the day to expose is from 10 am in the morning till 2-3 pm in the afternoon during summers.

Vitamin D extraction from the mushrooms was done by the saponification method and was estimated for vitamin D content using High Pressure Liquid Chromatography technique. Potassium Hydroxide, Ascorbic Acid Solution, Vitamin Standards {A, E, D_3, K_1 and K_3}, Petroleum Benzene (Analytical grade), Milli-Q water conforming IS: 1070-1991, Reagent Water Quality; Grade II Methanol (HPLC Grade), Sodium sulphate were the reagents used for the estimation. A blank solution was prepared adopting the procedure that is used for sample preparation, with equal quantities of all reagents used and ignoring the sample. Prepare equal volumes of sample as blank solution.

Blank, Standard (Minimum at 3 different concentrations, from 10-100 mg/L), Blank, Sample and Spike was the sequence followed.

The moisture free sample was taken in a silica crucible (after dry weight determination) and treated in muffle furnace at 600-800°C for 2-3 hours. Then it is left in a desiccator for cooling to room temperature after which the weight was taken to determine the amount of ash content.

Calcium estimation was done by the titrimetric method using HCl solution, 10% hydroxylamine hydrochloride solution, 10% potassium thiocyanate, 0.01M magnesium complex of EDTA, EBT Indicator and buffer solution. Phosphorous estimation was done using stannous chloride, sulphuric acid, ammonium molybdate and standard phosphate solution by colorimetric method.

The product was developed in two forms like whole wheat phulka and whole wheat paratha and had further undergone the sensory evaluation to asses which product was more acceptable. Further the shelf life of the developed product was also checked in respect to the microbial spoilage due to the factors like exposure to light and heat and trans-

mission of gases (including humidity). The product was stored at both room and refrigeration temperature in aluminum foil and plastic in both the cases to check the influence of packaging material on the shelf life of the product.

Results and Discussion

Recommended daily allowance for vitamin-D is not met by most of the age group through dietary intake in spite of knowing its importance. It is well known that sunlight is the major source of the vitamin which is not reaching the proper site of synthesis due to usage of sunscreen lotions and sun protection creams. Since this study revolves around this micronutrient, food fortification method was tried out in a popular local food item consumed on a daily basis — paratha.

In fresh mushrooms, ergosterol gets stimulated to convert to Vitamin D_2 by ultraviolet light, either from sunlight or artificial lights like UV lamps. The mushroom was exposed to sunlight during the months of March and April and was sun exposed for 3-4 hours daily for 2 days from 10am to 2pm. After drying the mushrooms in the sun there was loss of moisture and they appear to be crispy, flaky and brown in color and also had a distinct odor. Hence there was a complete change in the physical characteristics of the sun exposed mushrooms. The mushrooms were analyzed for their vitamin D content through the HPLC method and after the extraction and determination the result showed that the fresh mushrooms had 2480IU/100Gms, 7 hours exposed mushrooms contained 69680 IU/100Gms and 9 hours exposed mushrooms contained 63680 IU/100Gms. So it can be concluded that there was a significant increase in the levels of Vitamin D of the mushrooms after exposure to sunlight for 7 hours. The results of ashing showed that mushrooms contain 20% of ash. Mushrooms contain some important minerals such as calcium, phosphorous, zinc, magnesium and potassium. Out of these calcium and phosphorous are the most important minerals as they are associated with the absorption and regulation of Vitamin D in the body. The fresh mushrooms had 5.9mg; 7 hours sun exposed mushrooms had 6.6mg and 9 hours sun exposed mushrooms had 6.06mg of calcium. This proves that the sunlight exposure does not have any effect on calcium levels. But the product developed showed low levels of Vitamin D and it contained only 2.17mg/100ml which is less when it was compared to the fresh and the exposed mushrooms. The loss of calcium could be due to interaction with other nutrients or loss during the cooking process. The phosphorus content present in fresh mushrooms, sun exposed mushrooms for 7hours and 9hours and the product developed is 70mg/ml, 100mg/ml, 90mg/ml and 70mg/ml respectively. It can be noted that there was a slight increase in the phosphorus content on sun exposure which decreased in the product developed. The sensory evaluation was done to standardize the 2 products and the scores based on color, texture, and appearance showed us that people preferred paratha more than the phulka. It could be because the phulka tasted dry and the paratha tasted nice and soft because of the oil used which contributed towards the moisture content of the product.

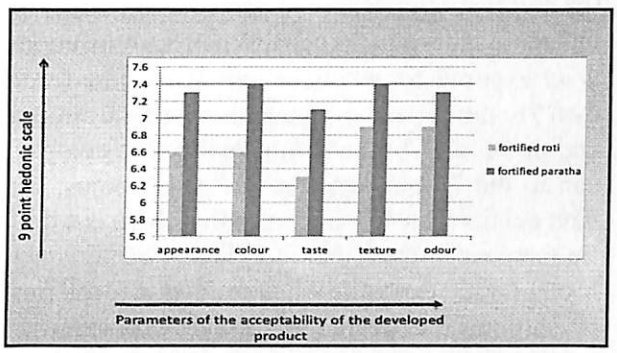

Fig 1: Sensory evaluation of the product

Further the results also throw light on the amount of vitamin D in the developed product which is 1000 IU/100Gms which when compared to the sun exposed mushrooms is very less. There has been a tremendous loss of Vitamin D in the product which could either be due to the interaction with other nutrients or due to the involvement of high temperature during the preparation of the fortified product.

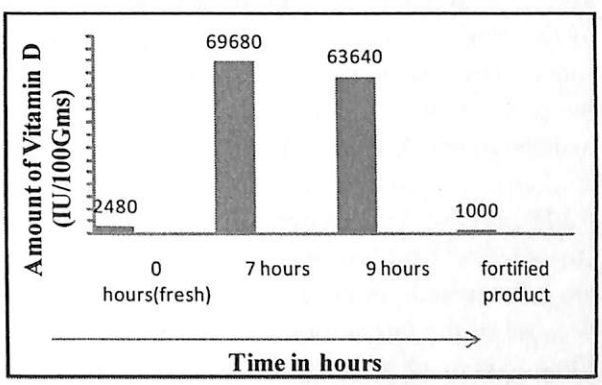

Fig 2: Amount of Vitamin D in fresh and exposed mushrooms and fortified product

Shelf life studies were also done on the developed product by keeping it in two different temperature conditions and in two different types of packaging materials. The results concluded that there was no significant contribution of the packaging materials towards the stability of the product, since spoil-

age was observed in both the aluminium foil and plastic package. The product was spoilt at room temperature quicker than the one kept at low temperature. The product kept at room temperature showed spoilage within two days of storing, whereas the refrigerated product showed microbial spoilage by the fourth day.

Conclusion

The main objective was to see whether exposing of the mushrooms to the sun can lead to an increase in its vitamin D content or not. The experimental data clearly indicates that the mushrooms can synthesize vitamin D on being exposed to sunlight and the duration of exposure to sunlight did affect the vitamin synthesis in the cells. When the mushrooms were exposed for a longer period of time (more than 9 hours), it lead to an overexposed mushrooms and the levels of the vitamin reduced in comparison to the 7 hour sun exposed mushrooms. The data obtained clearly indicates that there is a drastic increase in the Vitamin D levels of the mushrooms on sun exposure when compared to the fresh mushrooms, but decreased on over exposing.

The product developed was paratha fortified with mushrooms enriched with Vitamin D on sun exposure. The sensory scores were analyzed by nine point hedonic scale and the results indicates that the fortified paratha prepared from 15 gms of nine hour exposure to sunlight mushroom powder was considered best in terms of sensory score.

Results also indicate that there was a change in the levels of phosphorous when compared with the sun exposed mushrooms. Calcium levels also seemed to deplete in the product when compared to the fresh mushrooms and sun exposed mushrooms. This lose in mineral levels could be due to the processing techniques which the product had to undergo which involved a high temperature. The product had depleted levels of Vitamin D in it which could possibly be because of the product being subjected to heat treatment above 100°C during preparation and not being heat stable or could be because of the interaction of other nutrients with Vitamin D thereby leading to the loss of this vitamin. Results of the shelf life tests indicated that the product spoiled faster at room temperature and the type of packaging material used did not have any influence on the shelf life of the product.

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