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EDITORIAL

This July, 2010 issue of "Research Reach", as always, brings together an interesting blend of research findings documented by researchers across India in various topics of interest to Home Scientists. The fact that the articles are peer-reviewed by senior editorial board members adds value to the presentations.

With a rapidly growing population and concomitant increasing food demand, there is always a constant need for newer, improved and more effective food production and processing technologies. In this regard, the paper by Sarita et al with a focus on cooking characteristics of aerobic rice with lesser water need and the paper on improved varieties of processed anchovies by Sharmila et.al, are successful attempts in this direction. Manu et al's research work on the use of underutilized grains for product development emphasizes on value addition and its role in food security.

Critical care of hospitalized patients is one of the major challenges faced by Indian dietitians today. There is always a quest to develop economical and cost effective enteral feeds that can be made affordable for long term treatments in our country. The paper by Dhruvi Bal on development of enteral formulations deals with newer therapeutic interventions developed using natural resources. Details of the economics of manufacture and the possibility of involvement of women of self help groups (SHG) in its manufacture makes interesting reading.

Several educational programs have been initiated across India to improve literacy rates and one such program in Rajasthan is the "Janshala Program" for girls and marginalized populations in urban slums. The paper by Ruby and Shikha evaluates this program using a wide range of evaluation criteria.

Consanguinity refers to the property of being of the same lineage as another person. Consanguineous marriages or a marriage between first cousins is prevalent in several Asian communities including India. The paper by Chandra & Siranjoti examines the health status of off springs of consanguineous partners.

The editor and the editorial board members of the journal will continue to strive to present interesting and relevant current research that would be useful to teachers, students and researchers. Our success, however, will depend largely on authors who submit well written papers, with a focus on science along with quality in language and format of presentation. We request all authors to bear this in mind while submitting articles for the journal,

Chief Editor,
Dr. Malathi Sivaramakrishnan.

INSTRUCTIONS TO THE AUTHORS

Research Reach- Journal of Home Science (ISSN 0974 – 617X) is devoted to original Research and Development in all branches of Home Science. It is a bi-annual publication from the Research Centre, College of Home Science, Nirmala Niketan, 49, New Marine Lines, Mumbai – 400020.

The format of the journal includes (using **Font- Times New Roman 12**):

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3. Research notes limited to a maximum of 2-6 typed pages
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The article should cover:

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References should also be typed at the end of the paper giving full details. The format should be as follows

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The editorial board deserves the right to edit the manuscripts in order to make them suitable for publication in the journal and the judgment of the reviewing expert regarding the quality of the paper is final.

Information / Views / Data published in the journal are of the authors only.

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SENSORY AND MICROBIAL ASSESSMENT OF NEWLY DEVELOPED PROCESSED ANCHOVY

Sharmila R., Annette Beatrice.D and Esther Lydia
Department of Home Science, Women's Christian College,
Chennai -600 006.

Anchovy belongs to the family of Engraulidac which consists of largely Marine fish. Anchovy is high in protein and calcium and is rich in Omega -3 fatty acids. The objective of this study was to determine the effect of processing on Anchovy using judicious combinations of ingredients and spices (Product A-chilli powder and curry leavaes, Product- B Chilly powder and gongura paste; product C-chilly powder and dry mango powder and Product D-tomato and chilli sauce) and was dried using microwave oven. The sensory and microbial properties of the processed Anchovies were investigated. The nutritive value of all the four products was high in protein and calcium. The calcium content of all the four products met the Recommended Dietary Allowance for calcium for adult Indians. The results revealed that organoleptic characteristics such as appearance, color, taste, texture and flavor and overall acceptability properties of all the four processed anchovy products were high, with the overall acceptability score of more than 4.0 to a maximum of 5.0. The Evaluation of the microbial quality on the 1st and 15th day of storage in polythene covers revealed lowest bacterial count and microorganisms like salmonella, staphylococcus pseudomonas, yeast and moulds were not present in all the four products. Therefore we conclude that all the four products give a good quality of processed Anchovy with higher nutritional quality and acceptable consumer attitude with regard to sensory characteristics and shelf life.

KEY WORDS: Anchovy, standardization, sensory quality and microbial quality.

INTRODUCTION

Several sources of information suggest that man evolved on a diet with a ratio of omega 6 to omega 3 fatty acids of approximately ratio 1 whereas today this ratio is approximately 10:1 to 20-25:1, indicating that today's diets are deficient in omega 3 fatty acids compared with the diet on which humans evolved and for which their genetic patterns were established. Many studies show that in patients with hyperlipidemia, omega 3 fatty acids decrease low-density-lipoprotein (LDL) cholesterol if the saturated fatty acid content is decreased, otherwise there is a slight increase, but at high doses (32 g) they lower LDL cholesterol; furthermore, they consistently lower serum triglycerides in normal subjects and in patients with hypertriglyceridemia whereas the effect on high-density lipoprotein (HDL) varies from no effect to slight increases. Because omega 3 fatty acids are essential in growth and development throughout the life cycle, they should be included in the diets of all humans. Omega-3 and omega 6 fatty acids are not interconvertible in the human body and are important components of practically all cell membranes. EPA and DHA are widely available in cold water oily fish, such as mackerel, herring, salmon, sardines halibut, mackerel, and anchovies. Anchovy is a species that belong to the Engraulidac family. They provide high quality protein and have a high proportion of essential amino acids and are also a valuable source of minerals and fat rich in long chain omega-3 fatty acids, DHA and EPA. Hence Anchovy would be suitable for inclusion in the formulation of low fat highly unsaturated diets. Proper post harvest handling and processing are key factors which enhance revenues in fish sales. The poor quality of

sand dried Anchovy has had a negative effect on the export of Anchovy from India. Infestation by fly larvae is the greatest source of loss of fish during sun drying. There may also be losses due to scavenging birds and animals. During periods of high humidity and clouds, fish may spoil through bacterial or mold growth during drying. Fat in the Anchovy may become rancid during drying. Consequently, the product of salted-dried anchovy is very susceptible for microbiological, chemical and sensory deterioration. Dried anchovies are found to have 9.69% moisture and lowest salt content of 2.22% and thus found to have high cadaverin and putrescine forming bacteria. (Jeyasekaran and Jeya S., 2003) But when this is replaced by high quality micro waved Anchovy it can improve the quality and rule out the inherent problems of traditional drying like contamination, high unsanitary conditions, lack of protection from rain though it has a low labor cost and zero capital.

MATERIALS AND METHODS

Processing

Anchovy of good quality were selected, washed, cleaned and subjected to treatment with various ingredients like (Curry leaves powder, gongura paste, dry mango powder and tomato and chilli sauce which have antimicrobial properties) and were dried in a microwave oven. These ingredients in addition to their antimicrobial property, add value to the product by decreasing the salt concentration and at the same time increasing the nutrient content like calcium, fibre and vitamins which result in enhanced quality (Value-added) products. The four processed Anchovy products developed were:

Product A- Anchovies, salt, turmeric powder, chilli powder and curry leaves

Product B-Anchovies, salt, turmeric powder, chilli powder and gongura paste

Product C-Anchovies, salt, turmeric powder, chilli powder and dry mango powder

Product D-Anchovies, salt, turmeric powder, tomato sauce and chilli sauce

Sensory Analysis

Products A, B, C, D were standardized and assessed for acceptability using the sensory method of evaluation. The processed anchovies were evaluated using a five point score card. Descriptive qualities were attributed to each score as a guide for panel members. The processed anchovies were evaluated for attributes like appearance, colour, flavor, taste, texture, over-all acceptability and were given a maximum score of five for excellence and a minimum score of one for poor quality. Semi-trained panelists carried out sensory evaluation of the quality of the product.

Nutrient analysis

The nutrient analysis was done to analyze the products for selected nutrients. The four developed newly developed processed anchovies were analyzed for selected nutrients such as energy, carbohydrate (Anthrone reagent), protein (Kjeldahl method), fat (ether extraction), fiber (enzymatic-gravimetric method), and calcium (acid digestion).

Shelf-life of the processed anchovies

The products were packed in sealed containers and the shelf life of the products was assessed using microbial analysis on the 1st day and 15th day. The microbial quality was assessed through the standard plate count, which was carried out through the pour plate method where in a sample (1ml) is pipetted and was mixed with an appropriate volume of molten agar. The number of colonies counted was multiplied by dilution factor to obtain the actual number of microorganisms present. The presence of pathogenic organism were identified with specific standard procedures.

RESULTS AND DISCUSSION

Nutrient Composition

The four newly developed processed anchovies were analyzed for selected nutrients and the results are presented in table 1.

Table 1: Nutritive value of processed anchovies

Nutrients	Values per 100g			
	Product	Product	Product	Product
	A	B	C	D
Energy (kcal)	54	73	55	51.2
Carbohydrate (g)	5.08	8.76	6.89	7.015
Fat (g)	0.67	0.787	0.1167	0.2165
Protein (g)	6.78	7.89	6.66	5.11
Fibre (g)	0.89	0.0076	0.0895	0.0115
Calcium (mg)	1022	890.3	786	930

The processed anchovies are low in energy, carbohydrate, and fat but high in protein and calcium. The calcium content of the products/100gm serving were found to be more than twice the Recommended Dietary Allowance for the Indian adults.

Sensory Evaluation of Processed Anchovy

A standard score card ranking from 5.0 to 1.0 for an excellent product to a product of poor quality respectively was used to score and identify the sensory quality of the four products. The products were evaluated on the 1st day and 15th day and the results are given in Table 2.

Table 2: Comparison of the sensory attributes of the processed anchovy A on the 1st and 15th day

Sensory attribute	N	Mean (max score=5)	Standard Deviation	't' Value	Level of Significance
Appearance 1 st Day	30	4.27	0.740	1.943	NS
Appearance 15 th Day	30	3.90	0.712		
Color 1 st Day	30	4.27	0.740	1.557	NS
Color 15 th Day	30	3.97	0.718		
Taste 1 st Day	30	4.37	0.765	2.902	1 %
Taste 15 th Day	30	3.77	0.728		
Texture 1 st Day	30	4.23	0.774	1.980	5 %
Texture 15 th Day	30	3.90	0.662		
Flavor 1 st Day	30	4.40	0.675	2.811	1 %
Flavor 15 th Day	30	3.83	0.791		
Overall Acceptability 1 st Day	30	4.20	0.714	2.164	5 %
Overall Acceptability 15 th Day	30	3.83	0.592		

NS-Not significant, 5% - significance at ($p < 0.05$), 1% is highly significant ($p < 0.001$)

Table 2 shows that the mean overall acceptability score was 4.20 on the 1st day and 3.83 on the 15th day. The table shows that there is no significant difference between sensory attributes like appearance and color, between the 1st day and 15th day. However sensory attributes like taste ($p < 0.001$), texture ($p < 0.05$), flavor ($p < 0.001$) and overall acceptability ($p < 0.05$) of the product A was significantly different between 1st day and 15th day. Attributes like taste, texture, flavour and overall acceptability was rated excellent with a mean score > 4 on a five point scale on the first day of sensory evaluation, however these attributes were rated very good with a mean score of 3 – 4 on a five point scale on the 15th day of sensory evaluation, indicating a significant change in these sensory attributes over time.

Comparison of the sensory attributes of the processed anchovy B on the 1st and 15th day
Comparison of the sensory attributes of the processed anchovy B on the 1st and 15th day is presented in table 3.

Table 3: Comparison of the sensory attributes of the processed anchovy B on the 1st and 15th day

Sensory attribute	N	Mean	Standard Deviation	t Value	Level of Significance
Appearance 1 st Day	30	4.03	0.765	1.578	NS
Appearance 15 th Day	30	3.67	0.802		
Color 1 st Day	30	3.90	0.885	1.242	NS
Color 15 th Day	30	3.57	0.935		
Taste 1 st Day	30	4.33	0.661	2.757	1 %
Taste 15 th Day	30	3.73	0.944		
Texture 1 st Day	30	4.10	0.662	2.765	1 %
Texture 15 th Day	30	3.67	0.711		
Flavor 1 st Day	30	3.90	0.845	1.469	NS
Flavor 15 th Day	30	3.60	0.814		
Overall Acceptability 1 st Day	30	4.03	0.556	2.538	5 %
Overall Acceptability 15 th Day	30	3.60	0.724		

NS-Not significant, 5% - significance at ($p < 0.05$), 1% is highly significant ($p < 0.001$)

Table 3 shows an overall acceptability score of 4.03 on the 1st day and 3.60 after 15 days of storage. There was no significant difference in the attributes appearance and color between the 1st and 15th day, whereas a significant difference was observed in sensory attributes like taste, texture and overall acceptability.

Attributes like taste, texture, and overall acceptability was rated excellent with a mean score >4 on a five point scale on the first day of sensory evaluation, however these attributes were rated very good with a mean score of 3 – 4 on a five point scale on the 15th day of sensory evaluation, indicating a significant change in these sensory attributes over time.

Comparison of the sensory attributes of the processed anchovy C on the 1st and 15th day

Comparison of the sensory attributes if the processed anchovy C on the 1st and 15th day is presented in table 4.

Table 4: Comparison of the sensory attributes of the processed anchovy C on the 1st and 15th day

Sensory attribute	N	Mean	Standard Deviation	t Value	Level of Significance
Appearance 1 st Day	30	4.17	0.648	0.829	NS
Appearance 15 th Day	30	3.80	0.761		
Color 1 st Day	30	3.97	0.928	0.757	NS
Color 15 th Day	30	3.80	0.847		
Taste 1 st Day	30	3.87	0.973	1.204	NS
Taste 15 th Day	30	3.53	1.074		
Texture 1 st Day	30	3.90	0.923	1.511	NS
Texture 15 th Day	30	3.60	0.855		
Flavor 1 st Day	30	3.97	0.928	1.688	NS
Flavor 15 th Day	30	3.53	1.042		
Overall Acceptability 1 st Day	30	3.97	0.669	1.980	NS
Overall Acceptability 15 th Day	30	3.63	0.850		

NS-Not significant, 5% - significance at ($p < 0.05$), 1% is highly significant ($p < 0.001$)

Table 4 indicates that there is no significant difference in attributes on the 1st and 15th day. This shows that dry mango powder when added to the product retained the sensory quality without a significant change in sensory properties.

Comparison of the sensory attributes of the processed anchovy D on the 1st and 15th

Comparison of the sensory attributes of the processed anchovy D on the 1st and 15th day is presented in table 5.

Table 5: Comparison of the sensory attributes of the processed anchovy D on 1st and 15th

Sensory attributes	N	Mean	Standard Deviation	't' Value	Level of Significance
Appearance 1 st Day	30	3.90	0.923	1.943	NS
Appearance 15 th Day	30	3.53	0.819		
Color 1 st Day	30	4.03	0.718	2.183	5 %
Color 15 th Day	30	3.73	0.765		
Taste 1 st Day	30	4.10	0.995	2.067	5 %
Taste 15 th Day	30	3.53	0.973		
Texture 1 st Day	30	4.17	0.791	3.393	1 %
Texture 15 th Day	30	3.57	0.774		
Flavor 1 st Day	30	4.20	0.887	3.802	1 %
Flavor 15 th Day	30	3.43	0.728		
Overall Acceptability 1 st Day	30	4.00	0.695	2.379	5 %
Overall Acceptability 15 th Day	30	3.53	0.776		

NS-Not significant, 5% - significance at ($p < 0.05$), 1% is highly significant ($p < 0.001$)

Table 5 indicates that there was a significant difference in sensory attributes like color, taste, texture, flavor, and overall acceptability of processed anchovies D between the 1st day and 15th day. All the attributes except for appearance was rated excellent with a mean score > 4 on a five point scale on the first day of sensory evaluation, however these attributes were rated very good with a mean score of 3–4 on a five point scale on the 15th day of sensory evaluation, indicating a significant change in these sensory attributes over time.

Shelf-life of the Processed Anchovy

Microbial quality of all the four newly developed processed anchovies was analyzed in terms of aerobic plate count and E.coli, staphylococcus, salmonella, pseudomonas and yeasts and moulds. The microbial analysis of processed anchovies are presented in table 6

Table 6: Microbial analysis of processed anchovies

Test	Processed anchovy							
	A		B		C		D	
	1 st day	15 th day	1 st day	15 th day	1 st day	15 th day	1 st day	15 th day
Total bacterial count	20 cfu/g	30 cfu/g	20 cfu/g	35 cfu/g	25 cfu/g	60 cfu/g	5 cfu/g	35 cfu/g
Escherichia coli	0	0	0	0	0	1	0	0
Salmonella sps	0	0	0	0	0	0	0	0
Staphylococcus aureus	0	0	0	0	0	0	0	0
Pseudomonas aeruginosa	0	0	0	0	0	0	0	0
Yeast & mould	0	0	0	0	0	0	0	0

Note: cfu /g – colony forming units/grams, 0- Absence of microorganism, 1- Presence of microorganism

Table 6 showed that none of the products exceeded the aerobic plate count of colony forming units per gram (cfu/g). E.Coli was detected only in product C. None of the products were positive for staphylococcus, salmonella, pseudomonas, yeasts and moulds.

Overall results revealed that the products were processed under hygienic conditions and the anchovies under processing had exerted good process control in order to maintain superior microbial quality of the products thereby increasing the shelf life. Microwave drying, effectively reduced spoilage bacteria thus extending the shelf life of the product. Extension of the shelf life and stability of the products may enhance their commercial potential by allowing sales beyond locality of its production/ processing.

CONCLUSION:

Anchovy are rich source of calcium and protein. This acts as good supplement for children, adolescents, and adults. Dry fish are normally high in salt concentration. As the anchovies are dried in microwave, the four newly developed products will be less in salt concentration and at the same time the spices added to the product will give antimicrobial property. No oil is used in frying. This will help in the dietary plan of people who need to take less fat in their diet at the same time have a variety of products which are safe, stable, nutritious, tasty and economical. This judicious combination of different ingredients will give a product not only good to taste and low in fat but also safe for consumption.

An analysis of the studies of both the domestic and export provided several important insights into the potential for developing value-added and higher quality products. Anchovy is a highly desirable product amongst a wide range of socio-economic groups in many countries, ranging from West Asia through South Asia to Southeast Asia. Extension of the shelf life stability of the

products may enhance its commercial potential and at the same time meet the needs of the population who want a variety in foods at the same time a heart healthy diet.

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SUPPLEMENTATION OF TRADITIONAL *SEVIAN* WITH UNDERUTILIZED GRAINS: IMPROVEMENT IN MINERAL PROFILE

Manu, Darshan Punia* and N. Khetarpaul

Department of Foods and Nutrition
CCS Haryana Agricultural University
Hisar-125004, India

In North India, traditionally, *sevian* are prepared with wheat flour. In present investigation traditional wheat flour *sevian* were supplemented with underutilized grains (horsegram and ragi) to improve their mineral composition. The total, HCl-extractable and available calcium content of wheat *sevian* increased significantly with the supplementation of underutilized grains. Among all the supplemented *sevian*, *sevian* prepared with the combination of wheat, *bajra* and ragi contained maximum amount of calcium. Supplementation of ragi to control *sevian* did not bring any significant change in total iron content. All other supplemented *sevian* had significantly higher total iron as compared to control *sevian*. *Sevian* prepared from *bajra* and horsegram had highest amount of HCl-extractable iron. Supplementation of underutilized grains did not bring any significant change in ionizable and *in vitro* iron except in the *sevian* prepared with *bajra* and horsegram, which contained significantly higher amount. The phosphorus content in all supplemented *sevian* decreased significantly as compared to control. Among all supplemented *sevian*, *sevian* prepared with wheat and horsegram had maximum amount of total phosphorus and *sevian* prepared with wheat and ragi had maximum HCl-extractable phosphorus. Total and HCl-extractable magnesium and potassium content increased as a result of supplementation of *sevian* with underutilized grains. Among the supplemented *sevian*, *sevian* prepared with *bajra* and horsegram contained maximum amount of total and HCl-extractable magnesium and potassium contents. Supplementation of *sevian* with underutilized grains had no effect on zinc content. Total and HCl-extractable copper was increased as a result of supplementation of *sevian* with underutilized grains. Among the supplemented *sevian*, *bajra sevian* supplemented with horsegram had highest amount of total and HCl-extractable copper.

KEY WORDS: *sevian*, underutilized grains, horsegram, ragi, supplementation, minerals

INTRODUCTION

Rural Indians mainly depend on the staple foods for their livelihood. In rural Haryana, wheat and *bajra* are staple cereals in summer and winter, respectively. Enrichment of staple foods is universally recognized as an effective means for meeting daily requirements for a range of nutrients (Richardson, 1997). The dietary modification to increase the consumption of nutrient dense underutilized grains is the safest and most sustainable strategy to improve nutritional status of rural populations.

Ragi (finger millet) usually ranks third in cereal production in semi-arid regions of the globe, after sorghum and pearl millet. Ragi is an uncommonly used grain in North India specially Punjab and Haryana State. Ragi is unique among cereals in being a very rich source of calcium

containing 0.3 to 0.4 g percent of calcium as compared to other cereals which contain only 0.01 to 0.04 g percent. Ragi also contains a good amount of other minerals like phosphorus, iron, magnesium and dietary fibre. Horsegram is an unexploited legume of the tropics and subtropics grown mostly under dry land agriculture. Its nutritive value is typical of legumes with a high percentage of protein (Manage and Sohoni, 1972) and it is an excellent source of iron and a fairly good source of calcium. This paper reports the mineral profile of traditional sevian supplemented with underutilized grains, ragi and horsegram.

MATERIALS AND METHODS

Materials: Wheat, ragi and horsegram were procured from Forage Section, Deptt. of Plant Breeding, CCSHAU, Hisar, India. Wheat, ragi and horsegram were cleaned and made free from dust, dirt and other foreign materials. Cleaned wheat, ragi and horsegram were ground into flour in the flour mill to obtain a fine flour. *Sevian* were prepared from whole wheat flour, bajra flour, ragi and horsegram using the conventional method.

Preparation of *sevian*: The various proportions of flours used for the preparation of supplemented sevian were as follows:

Type of <i>sevian</i>	Wheat flour (g)	Bajra flour (g)	Ragi flour (g)	Horsegram flour (g)
Control	150	-	-	-
1	120	-	30	-
2	135	-	-	15
3	-	105	-	45
4	75	30	45	-
5	75	30	30	15

The various flours were mixed and made into a dough with water. A small portion of the dough was put in the *sevian* making machine and made into *sevian*. The *sevian* was spread on muslin cloth and dried in the shade. The *sevian* so made was roasted in a *pan* using ghee until golden brown in colour. Water was added and the pan was covered as per the recipe. When half cooked, sugar was added. The *sevian* was cooked until done and till all the water was absorbed by the *sevian*.

Organoleptic evaluation of *sevian*: The prepared *sevian* were evaluated organoleptically for their colour, appearance, flavour, texture, taste and overall acceptability by a panel of ten judges using a 9- point hedonic scale.

Preparation of sample: *Sevian* were dried in a hot air oven at 60°C. The dried samples were ground in Cyclotec Sample Mill to a fine powder and stored in air tight plastic containers till further analysis.

Mineral analysis: The dried samples (in triplicate) were used for analysis of minerals.

Acid digestion: Two grams of dried and ground sample was taken in a 150 ml conical flask. To this was added 20 ml diacid mixture (HNO_3 : HClO_4 : 5:1, v/v) and kept overnight. The contents were digested by heating till a clear white precipitate settled down at the bottom. The crystals were dissolved in double distilled water. The contents were filtered through Whatman # 42 filter paper. The filtrate was made to 50 ml volume with double distilled water and used for determination of total minerals.

Calcium, magnesium, iron, zinc and copper were determined by Atomic Absorption Spectrophotometer according to the method of Lindsey and Norwell (1969). Potassium was determined by using Flamephotometer. Phosphorus was determined colorimetrically (Chen *et al.*, 1956).

HCl-extractable minerals were assessed by employing the method of Peterson *et al.* (1943). Minerals including calcium, phosphorus, iron, zinc, copper, magnesium and potassium were extracted in 0.03 N HCl to assess availability of these minerals in the samples.

Extraction: To one gram sample, 50 ml 0.03 N HCl was added. The mixture was incubated at 37°C in a shaker-cum-water bath for 3 hours to simulate conditions that occur in the human stomach. At the end of the incubation period, the mixture was filtered through an ashless filter paper (Whatman No. 42). The filtrate was analysed for minerals. Calcium, magnesium, iron, zinc and copper were determined by the methods described earlier on.

Availability of minerals

Available calcium was extracted by the method of Kim and Zemel (1986). Ionizable iron in the samples was extracted according to the procedure of Rao and Prabhavathi (1978), and was determined by the standard method (AOAC, 1995).

Statistical analysis: Suitable standard statistical methods were used for analysis of the data.

RESULTS AND DISCUSSION

Organoleptic evaluation of *sevia*: Mean organoleptic scores of *sevia* made from wheat and *bajra* using underutilized grains have been presented in Table 1. Results revealed that all the supplemented *sevia* were acceptable organoleptically. The scores for colour and appearance of wheat *sevia* (control) fell in the category of 'liked moderately'. Supplementation of wheat *sevia* with ragi and horsegram had no effect on colour and appearance of supplemented *sevia*. The *sevia* prepared from wheat, *bajra*, ragi and horsegram had the lowest score for colour. The colour and appearance of *bajra* supplemented with ragi and horsegram *sevia* did not differ significantly from each other. The flavour and texture of wheat *sevia* (control) was 'liked moderately', and was not affected by supplementation with *bajra*, ragi and horsegram, however, maximum score was given to *sevia* prepared by supplementing ragi with wheat. The *sevia*

prepared from wheat (control) as well as *bajra* and underutilized grains (supplemented) were 'liked moderately' in terms of overall acceptability. The mean scores for overall acceptability of Table 1. Mean scores of sensory characteristics of *sevian*

<i>Sevian</i>	Total calcium	Percentage of RDA	HCl-extractable calcium	Available calcium
Control (100% wheat)	40.67 ^f ± 0.23	10.17	30.17 ^f ± 0.10 (74.19)	25.04 ^f ± 0.09 (61.58)
Wheat + Ragi (80:20)	78.77 ^e ± 0.13	19.69	63.27 ^e ± 0.16 (80.33)	51.80 ^e ± 0.12 (65.76)
Wheat + Horsegram (90:10)	53.53 ^c ± 0.03	13.38	41.31 ^c ± 0.06 (77.17)	32.60 ^c ± 0.11 (60.90)
<i>Bajra</i> + Horsegram (70:30)	77.22 ^d ± 0.03	19.31	60.80 ^d ± 0.12 (78.74)	41.70 ^d ± 0.11 (54.00)
Wheat + <i>Bajra</i> + Ragi (50:20:30)	102.13 ^a ± 0.11	25.53	79.09 ^a ± 0.05 (77.44)	63.39 ^a ± 0.11 (62.07)
Wheat + <i>Bajra</i> + Ragi + Horsegram (50:20:20:10)	95.53 ^b ± 0.13	23.88	73.25 ^b ± 0.12 (76.67)	57.58 ^b ± 0.10 (60.27)
CD (P<0.05)	0.41		0.34	0.33

Values are mean ± SE of ten independent determinations.

ragi supplemented wheat *sevian* was significantly higher as compared to horsegram and *bajra* supplemented *sevian*. Dod (2003) reported that sensory characteristics of supplemented *sevian* fell in the category of 'liked slightly'.

Minerals

Calcium: The data on calcium content of *sevian* are presented in Table 2. The total calcium content of wheat *sevian* (control) was 40.67 mg/100 g, which increased significantly (P<0.05) with the addition of underutilized grains. All types of *sevian* varied significantly (P<0.05) among themselves in their calcium content. Among all the supplemented *sevian*, *sevian* prepared with the combination of wheat, *bajra* and ragi contained the maximum amount of total calcium (102.13 mg/100 g), which can fulfill 1/2 the daily calcium requirement of an adult for each 100gm serving. It was observed that ragi supplemented *sevian* had significantly (P<0.05) higher amount of calcium as ragi is a rich source of calcium.

With the addition of underutilized grains in wheat *sevian* (control), the amount of HCl-extractable calcium was increased from 30.17 mg/100 g in control wheat *sevian* to 79.09 mg/100 g in *sevian* prepared with combination of wheat, *bajra* and ragi. The HCl-extractable calcium ranged from 41.31 to 79.09 mg/100 g and percent extractability of calcium was between 76.67 to 80.33 in various supplemented *sevian* which was higher than control *sevian*. The available calcium also increased significantly ($P<0.05$) as a result of incorporation of underutilized grains in wheat *sevian*. The maximum available calcium was found in *sevian* prepared with wheat, *bajra* and ragi (63.39 mg/100 g) and minimum in *sevian* with wheat and horsegram (32.60 mg/100 g). Higher calcium content in supplemented *sevian* could be due to incorporation of underutilized grains.

Table 2: Calcium content of *sevian* (mg/100 g, dry weight basis)

<i>Sevian</i>	Total calcium	Percentage of RDA	HCl-extractable calcium	Available calcium
Control (100% wheat)	40.67 ^f ± 0.23	10.17	30.17 ^f ± 0.10 (74.19)	25.04 ^f ± 0.09 (61.58)
Wheat + Ragi (80:20)	78.77 ^e ± 0.13	19.69	63.27 ^e ± 0.16 (80.33)	51.80 ^e ± 0.12 (65.76)
Wheat + Horsegram (90:10)	53.53 ^e ± 0.03	13.38	41.31 ^e ± 0.06 (77.17)	32.60 ^e ± 0.11 (60.90)
<i>Bajra</i> + Horsegram (70:30)	77.22 ^d ± 0.03	19.31	60.80 ^d ± 0.12 (78.74)	41.70 ^d ± 0.11 (54.00)
Wheat + <i>Bajra</i> + Ragi (50:20:30)	102.13 ^a ± 0.11	25.53	79.09 ^a ± 0.05 (77.44)	63.39 ^a ± 0.11 (62.07)
Wheat + <i>Bajra</i> + Ragi + Horsegram (50:20:20:10)	95.53 ^a ± 0.13	23.88	73.25 ^b ± 0.12 (76.67)	57.58 ^b ± 0.10 (60.27)
CD ($P<0.05$)	0.41		0.34	0.33

Values are mean ± SE of three independent determinations

Figures in parentheses indicate percentage

Means with same superscripts are not significantly ($P<0.05$) different

which are a rich source of calcium. Dod (2003) also reported increased calcium content in chickpea supplemented *sevian*. A higher amount of calcium was observed in ragi *sevian* (Begum *et al.*, 2003).

Iron: The data on iron content of different types of *sevian* are presented in Table 3. The total iron content in wheat *sevian* (control) was 5.04 mg/100 g, supplementation of ragi to control *sevian* did not bring about any significant change in the total iron content. All other supplemented *sevian* had significantly ($P<0.05$) higher total iron as compared to control. It was

observed that supplemented *sevian* can meet about upto 1/5th of the iron requirement of an adult. Dod (2003) reported that total iron content was increased significantly in chickpea supplemented *sevian*. Begum *et al.* (2003) reported higher values of total iron content in ragi based *sevian* than the values observed in the present study.

The extractable iron of control *sevian* and *sevian* prepared with wheat and horsegram and wheat, *bajra*, ragi and horsegram did not vary significantly. *Sevian* prepared from *bajra* and horsegram had the highest amount of HCl-extractable iron (5.21 mg/100 g). The ionizable iron and *in vitro* iron content of control wheat *sevian* was similar. Supplementation of underutilized grains did not

Table 3 : Iron content of *sevian* (dry weight basis)

<i>Sevian</i>	Total iron (mg/100 g)	Percentage of RDA	HCl-extractable (mg/100 g)	Ionizable iron (mg/100 g)	<i>In vitro</i> iron (%)
Control (100% wheat)	5.04 ^a ± 0.08	18	4.40 ^a ± 0.12 (87.38)	0.92 ^b ± 0.04 (18.25)	0.91 ^b ± 0.02
Wheat + Ragi (80:20)	5.28 ^d ± 0.08	18.86	3.95 ^{cd} ± 0.09 (74.81)	0.85 ^b ± 0.06 (16.10)	0.88 ^b ± 0.03
Wheat + Horsegram (90:10)	5.54 ^e ± 0.12	19.79	4.75 ^b ± 0.14 (85.81)	0.97 ^b ± 0.10 (17.56)	0.94 ^b ± 0.05
<i>Bajra</i> + Horsegram (70:30)	7.35 ^a ± 0.09	26.25	5.21 ^a ± 0.27 (71.03)	1.25 ^a ± 0.09 (17.00)	1.07 ^a ± 0.04
Wheat + <i>Bajra</i> + Ragi (50:20:30)	5.63 ^e ± 0.07	20.11	3.77 ^d ± 0.09 (66.96)	0.84 ^b ± 0.06 (14.92)	0.88 ^b ± 0.03
Wheat + <i>Bajra</i> + Ragi + Horsegram (50:20:20:10)	6.01 ^b ± 0.13	21.46	4.33 ^{bc} ± 0.08 (72.05)	0.92 ^b ± 0.04 (15.31)	0.92 ^b ± 0.02
CD (P<0.05)	0.29		0.45	0.21	0.10

Values are mean ± SE of three independent determinations

Figures in parentheses indicate percentage

Means with same superscripts are not significantly (P<0.05) different

bring about any significant change in the ionizable and *in vitro* iron except in the case of *sevian* prepared with *bajra* and horsegram, which contained significantly higher amount of ionizable and *in vitro* iron than other supplemented *sevian* as well as control.

Phosphorus, magnesium and potassium: The data regarding total and HCl-extractable phosphorus, magnesium and potassium are depicted in Table 4. The phosphorus content (total as well as HCl-extractable) of all supplemented *sevian* decreased significantly (P<0.05) as compared

to control. Among all supplemented *sevia*, wheat *sevia* prepared with horsegram had maximum amount of total phosphorus (281.58 mg/100 g) and *sevia* prepared with wheat and ragi had maximum HCl-extractable phosphorus (162.80 mg/100 g). All the supplemented *sevia* were significantly ($P < 0.05$) different from each other for their total and HCl-extractable phosphorus.

Total and HCl-extractable magnesium content increased as a result of supplementation of *sevia* with underutilized grains. Among the supplemented *sevia*, *sevia* prepared with bajra and horsegram contained maximum amount of total and HCl-extractable magnesium while *sevia* prepared with wheat and ragi and wheat and horsegram had minimum amount of total and HCl-extractable magnesium. The total as well as HCl-extractable magnesium content of wheat *sevia* supplemented either with ragi or with horsegram was almost similar.

Table 4: Total and HCl-extractable phosphorus, magnesium and potassium content of *sevia* (mg/100 g, dry weight basis)

<i>Sevia</i>	Phosphorus		Magnesium		Potassium	
	Total	HCl - extractable	Total	HCl - extractable	Total	HCl - extractable
Control (100% wheat)	294.75 ^a ± 0.10	168.55 ^a ± 0.14 (57.18)	91.65 ^a ± 0.12	65.44 ^a ± 0.25 (71.40)	209.39 ^a ± 0.11	200.11 ^a ± 0.13 (95.57)
Wheat + Ragi (80:20)	275.46 ^c ± 0.14	162.80 ^b ± 0.11 (59.10)	94.56 ^d ± 0.09	68.37 ^c ± 0.21 (72.30)	225.77 ^d ± 0.12	221.80 ^c ± 0.12 (98.24)
Wheat + Horsegram (90:10)	281.58 ^b ± 0.10	161.88 ^c ± 0.06 (57.49)	94.65 ^d ± 0.19	68.30 ^c ± 0.17 (72.16)	237.60 ^c ± 0.06	227.62 ^d ± 0.10 (95.80)
Bajra + Horsegram (70:30)	230.18 ^f ± 0.10	136.91 ^f ± 0.12 (59.48)	102.48 ^e ± 0.16	76.11 ^e ± 0.06 (74.27)	290.37 ^e ± 0.16	283.25 ^e ± 0.14 (97.55)
Wheat + Bajra + Ragi (50:20:30)	272.76 ^e ± 0.14	158.80 ^d ± 0.11 (58.22)	97.77 ^c ± 0.13	71.24 ^b ± 0.14 (72.87)	237.57 ^e ± 0.12	231.25 ^e ± 0.15 (97.34)
Wheat + Bajra + Ragi + Horsegram (50:20:20:10)	274.78 ^d ± 0.10	153.84 ^e ± 0.14 (55.99)	98.70 ^b ± 0.17	71.15 ^b ± 0.09 (72.09)	259.38 ^b ± 0.12	243.75 ^b ± 0.09 (93.97)
CD ($P < 0.05$)	0.36	0.37	0.45	0.52	0.36	0.38

Values are mean ± SE of three independent determinations

Figures in parentheses indicate percentage

Means with same superscripts are not significantly ($P < 0.05$) different

The total potassium content of control *sevia*n was 209.39 mg/100 g, which increased significantly ($P<0.05$) with the incorporation of underutilized grains, maximum being in *sevia*n prepared with *bajra* and horsegram and minimum in *sevia*n prepared with wheat and ragi. All the supplemented *sevia*n varied significantly ($P<0.05$) from each other for their total potassium content except in *sevia*n prepared with wheat and horsegram and *sevia*n with wheat, *bajra* and ragi. The decrease in phosphorus and increase in magnesium and potassium content of supplemented *sevia*n as compared to control might be due to the fact that wheat contained more amount of phosphorus and less amount of magnesium and potassium as compared to underutilized grains (Table 4.8). Begum *et al.* (2003) had reported 136 mg/100 g of phosphorus in *sevia*n prepared from ragi. Dod (2003) reported that phosphorus content increased with the incorporation of chickpea in wheat *sevia*n.

Zinc and copper: The data presented in Table 5 indicates that supplementation of *sevia*n with underutilized grains had no effect on zinc content.

Table 5: Total and HCl-extractable zinc and copper content of *sevia*n (mg/100 g, dry weight basis)

<i>Sevia</i> n	Zinc		Copper	
	Total	HCl extractable	Total	HCl extractable
Control (100% wheat)	1.40 ^a ± 0.11	1.19 ^a ± 0.11 (85.85)	0.48 ^d ± 0.01	0.34 ^d ± 0.05 (70.59)
Wheat + Ragi (80:20)	1.43 ^a ± 0.13	1.15 ^a ± 0.08 (81.16)	0.71 ^c ± 0.06	0.51 ^c ± 0.05 (72.50)
Wheat + Horsegram (90:10)	1.51 ^a ± 0.06	1.15 ^a ± 0.07 (76.65)	0.58 ^{cd} ± 0.05	0.41 ^{cd} ± 0.05 (70.98)
<i>Bajra</i> + Horsegram (70:30)	1.59 ^a ± 0.11	1.26 ^a ± 0.09 (79.65)	1.39 ^a ± 0.05	0.97 ^a ± 0.04 (69.88)
Wheat + <i>Bajra</i> + Ragi (50:20:30)	1.48 ^a ± 0.10	1.16 ^a ± 0.09 (78.77)	0.99 ^b ± 0.05	0.73 ^b ± 0.08 (73.78)
Wheat + <i>Bajra</i> + Ragi + Horsegram (50:20:20:10)	1.60 ^a ± 0.06	1.18 ^a ± 0.09 (73.55)	0.98 ^b ± 0.05	0.71 ^b ± 0.03 (72.62)
CD ($P<0.05$)	0.31	0.28	0.15	0.16

Values are mean ± SE of three independent determinations

Figures in parentheses indicate percentage

Means with same superscripts are not significantly ($P<0.05$) different.

Total and HCl-extractable zinc content of all different types of *sevia* ranged from 1.40 to 1.60 mg/100 g and 1.15 to 1.26 mg/100 g, respectively. A non-significant difference was observed in total and HCl-extractable zinc content of all types of *sevia*.

Total and HCl-extractable copper was increased as a result of supplementation of *sevia* with underutilized grains. Among the supplemented *sevia*, *bajra sevia* supplemented with horsegram had the highest amount of total and HCl-extractable copper (1.39 and 0.97 mg/100 g, respectively), while wheat *sevia* supplemented with horsegram had lowest amount of total (0.58 mg/100 g) and HCl-extractable copper (0.41 mg/100 g). The total as well as HCl-extractable copper content of wheat *sevia* supplemented either with ragi or with horsegram was the same in both types. Similarly, *sevia* prepared with wheat, *bajra* and ragi and *sevia* prepared with wheat, *bajra*, ragi and horsegram had same amount of total copper content. Higher copper content in supplemented *sevia* might be due to the fact that underutilized grains contained higher content of copper.

CONCLUSION

It was found that wheat *sevia* supplemented with underutilized grains were acceptable organoleptically, however, the overall acceptability of ragi supplemented wheat *sevia* was significantly higher as compared to horsegram and *bajra* supplemented *sevia*. The total and available calcium content of wheat *sevia* increased significantly with the supplementation of underutilized grains. *Sevia* prepared with the combination of wheat, *bajra* and ragi (total of 100gm) can fulfill $\frac{1}{4}$ the daily calcium requirement of an adult. *Sevia* prepared from *bajra* and horsegram had the highest amount of iron, and 100gm of this *sevia* can meet about $\frac{1}{5}^{th}$ the daily requirement of iron. Supplemented *sevia* could provide reasonable quantities of calcium, iron and magnesium. Therefore development and consumption of such value added traditional products are recommended which might contribute in improving the nutritional status of the population especially the vulnerable sections.

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COOKING CHARACTERISTICS OF DROUGHT ECO FRIENDLY AEROBIC RICE ACCESSIONS

Sarita, Vijayalakshmi, D. and Shashidhar, H.E. and Shilpa, H.
Department of Food Science and Nutrition
University of Agricultural Sciences, GKVK, Bangalore
E-mail: Sarita.rajan@gmail.com

Aerobic Rice is an alternative system of rice cultivation under non-puddled, non-flooded and aerobic soil consuming 50% less water and labour. Aerobic rice can be produced in areas with dwindling water supply. Since it does not produce methane, one of the major 'greenhouse gases' that contributes to global warming hence it is considered as eco-friendly. Grain quality is one of the important parameter that determines the overall acceptability and profitability of a variety. Rice is a cereal that is consumed mainly as whole milled and boiled grain. An experiment was conducted to study milling, physical and cooking characteristics of eleven aerobic rice genotypes. The head rice recovery ranged from 81.3 percent to 71.9 percent, grain length 5.35 to 6.81 mm, breadth 1.52 to 1.97 mm, L / B ratio 2.83 to 4.26 mm, and grain width 1.95 to 2.88 mm, 1000 grain weight 15.5 to 23.6 g, and bulk density 0.81 to 0.85 (g / ml). As per dimensional classification IRRI 6, IRRI 259, and control samples were of fine type, Doddaverunellu coarse, and others common type. Cooking time ranged from 15 to 32 minutes, percent increase in weight 136 to 210, percent increase in volume 100 to 240, water uptake ratio 25.9 to 39.70, kernel elongation ratio 1.25 to 1.46, percent curled grain 15 to 99 and dispersed solids 2 to 4 percent respectively. Percent increase in volume, water uptake ratio, and kernel elongation ratio were positively correlated with sensory mean score whereas percent curled grains, and dispersed solids were negatively correlated with sensory mean score.

INTRODUCTION

Rice production in Asia needs to increase to feed a growing population. Though a complete assessment of the level of water scarcity in Asian rice production is still lacking, there are signs that declining quality of water and declining availability of water resources are threatening the sustainability of the irrigated rice-based production system. Drought is one of the main constraints for high yield in rain-fed rice. Exploring ways to produce more rice with less water is essential for food security and sustaining environmental health in Asia. Aerobic Rice, the term given by Bouman is a high yielding rice grown in non-puddled, non-flooded, aerobic (unsaturated) soil (i.e., soil with oxygen) under irrigation and high external inputs.

Rice (*Oryza sativa* L) has been dominant staple food for many centuries in Asia and Pacific, south and north America as well as Africa. In Asia alone more than 2 billion people obtain 60-70% of their calories from rice. In addition, it is also a good source of carbohydrates and B-complex vitamins. Rice forms an integral part of the culinary traditions of many different cultures, each of which has its own particular set of preference regarding the texture, taste, color and stickiness of the rice that they eat.

Rice varieties greatly differ in milling, physical and cooking characteristics. Varietal differences in terms of milling, physical, and cooking characteristics need to be investigated. Hence a study on milling, physical, and cooking characteristics of different varieties of aerobic rice (*Oryza sativa* L.) in comparison with a control sample (sona mansoori) was undertaken.

MATERIALS AND METHODS

Twelve varieties of paddy, eleven aerobic rice varieties and one control sample were procured from the department of Genetics and Plant breeding, University of Agricultural Science, Bangalore. Milling, physical, cooking, nutritional, and sensory characteristics were assessed in comparison with the control sample.

Milling: Paddy samples were cleaned and dried in sun and then de-husked using a grain miller at the department of Post-harvest Technology, G.K.V.K., Bangalore. The brown rice was subjected to 1-4 percent polishing and the milling fractions which include husk, brown rice, bran, broken rice and head rice were recorded for all the varieties selected.

Physical characteristics: The parameters studied under physical characteristics includes grain length, breadth, width, l/b ratio, 1000 kernel weight, bulk density, chalkiness, and dimensional classification of rice. Grain length (mm), breadth (mm) and width (mm) was determined by using vernier calipers holding the single grain lengthwise, breadth wise and widthwise, respectively. Length breadth (L/B) ratio was obtained by dividing the length of a single kernel by the corresponding breadth. 1000-Kernel weight (g): one thousand kernels each of the milled rice variety were counted randomly in duplicate and weighed in a electric balance. Bulk Density (g/ml): the volume of 100g of each sample (ml) was determined by gently pouring the grain into a 250 ml graduated cylinder. (Bhattacharya and Pushpa 2000). Chalkiness: the percent area of endosperm chalkiness was determined by using a scale suggested by Anon (1991). Dimensional classification of rice for marketing: Surface area per gram rice was calculated by measuring the length and breadth in mm and weight in mg respectively for a single grain and using the equation $S'' = 20(LB/W) \text{ (cm}^2\text{/g)}$ (Bhattacharya et al 1982)

Cooking qualities: The method suggested by Bhattacharjee and Kulkarni (2000) was followed to evaluate the cooking quality of different varieties. Weighed sample (2 g) was placed in test tubes containing boiling water (20 ml) and heated on boiling water bath. The following characteristics were evaluated:

1. **Cooking time:** Optimum cooking time was determined by pressing few kernels between two slides frequently taken from the cooking tube and noting the time when opaque core has just disappeared.
2. **Water uptake ratio:** The water uptake ratio was obtained by dividing the apparent water uptake at 90 C and the value was expressed in percentage $(W2-W1) \times 100$.
3. **Elongation ratio:** Elongation ratio was obtained by cooking rice in a wire basket for 10 minutes after 15 minutes of presoaking and then dividing the cumulative length of 20 cooked kernels by their respective length of raw kernels.

4. Percent curled grains on cooking: percent curled grains on cooking were obtained by cooking 100 rice grains in a wire basket for 10 minutes after 15 minutes of presoaking. The number of curled grains/100 grains in each variety was noted and expressed as percent of curled grains.
5. Dispersed solids: Solids leached out into the cooking water was determined as follows. The water drained out after cooking the rice was taken in a Petri dish and dried in a hot air oven and weighed.

$$\begin{aligned}
 \text{Weight of the Petri dish} &= W1 \\
 \text{Weight of the Petri dish + leached out solids after drying} &= W2 \\
 \text{Total leached out solids} &= W2 - W1 \\
 \text{Percent leached out solids} &= (W2 - W1) \times 100
 \end{aligned}$$

6. Aroma test: The evaluation of aroma was facilitated by boiling in water for 5 minutes before scoring. Descriptive scores given were either absent, faint or normal.

Sensory evaluation: Twelve varieties of rice samples were subjected to sensory evaluation in the cooked form to a panel of twenty judges and not more than two samples were presented at a time. Parameters evaluated by judges include color, grain size, texture, taste, and overall acceptability. A five point hedonic scale was used to evaluate the samples.

Four varieties from aerobic rice genotypes and one control sample (sona-mansoori), which had the least mean scores for overall acceptability in both raw and cooked form was selected for the preparation of processed product to find the differences. (Saritha 1991)

Statistical analysis: The results were analyzed using a completely randomized design (CRD) to compare the variance. Suitable tests were applied to know the significant differences among the selected rice varieties at $P \leq 0.05$ (Gomez and Gomez 1986).

RESULTS AND DISCUSSION

Milling fractions namely husk, brown rice, bran, head rice and polished rice per 100 g of paddy for aerobic rice samples are given in Fig 1.

Among aerobic rice varieties BI 27 had highest head rice recovery (81.3 percent) least being in IRRI 292 (71.9 percent). Brown rice yield (head rice + broken rice) was more in BI lines followed by IRRI 6. Varietal differences with respect to grain length, breadth, L/B ratio, grain width, 1000 kernel weight, bulk density and endosperm chalkiness is presented in Table 1.

Long grains are more accepted than short grains, whereas wider varieties are less acceptable. Lower the 1000 grain weight and bulk density, finer will be the grain. Chalkiness is an undesirable physical characteristic. Among aerobic rice varieties IRRI 6, IRRI 292 and Doddaverunellu had no chalky grains, IRRI 14, IRRI 49, IRRI 259, BI 27, BI 33, BI 43, and BI 48 had less than 10 percent and Moromutant had 10 to 20 percent endosperm chalkiness whereas control sample had no chalky grains

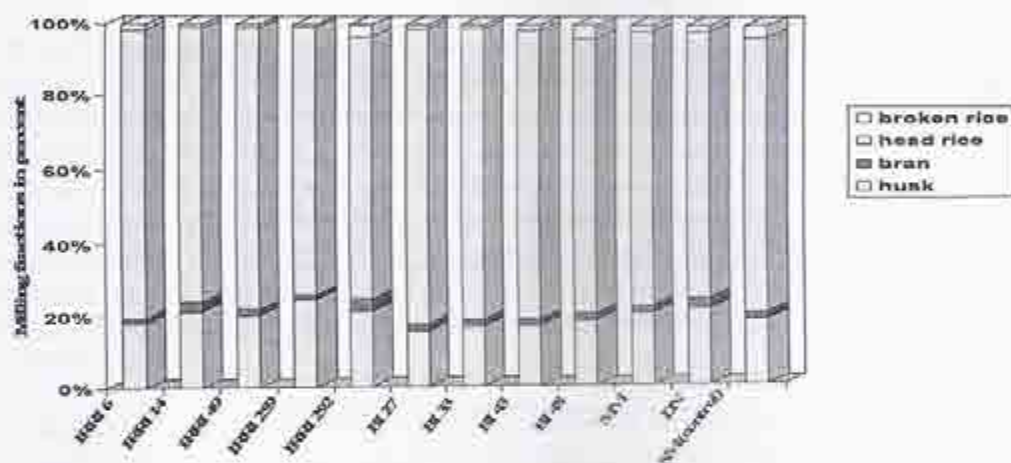


FIG 1. MILLING FRACTIONS PER 100 GRAM OF AEROBIC RICE PADDY

Table 1 : Physical characteristics of aerobic rice genotypes

Genotypes	Grain length (mm)	Breadth (mm)	L / B	Width (mm)	1000 grain weight (g)	Bulk density (g / ml)	Endosperm chalkiness (scores)
IRRI 6	6.47	1.52	4.26	1.95	15.5	0.81	0
IRRI 14	6.45	1.56	4.13	1.98	18.4	0.83	1
IRRI 49	6.73	1.73	3.89	2.01	19.5	0.83	1
IRRI 259	6.81	1.6	4.26	1.96	15.8	0.81	1
IRRI 292	5.48	1.68	3.26	2.6	19.5	0.85	0
BI 27	6.02	1.82	3.31	2.01	18.6	0.83	1
BI 33	6.14	1.82	3.37	2.04	19.0	0.83	1
BI 43	6.04	1.76	3.43	1.99	18.6	0.83	1
BI 48	6.09	1.76	3.46	2.02	17.6	0.85	1
Moromutant	5.35	1.71	3.13	2.2	17.4	0.85	5
Doddaverunellu	5.57	1.97	2.83	2.88	23.6	0.85	0
Sonamansoori	5.1	1.3	3.92	1.75	10.8	0.88	0
F value	26.43*	27.20*	22.71*	6.71*	66.61*	9.877*	14.76*
SEm _± (0.05)	0.117	0.013	0.099	0.043	0.414	0.0001	0.417
CD (0.05)	0.658	0.197	0.547	0.35	2.99	0.021	1.21

* Significant NS – Non-significant Sonamansoori - control

Table 2 : Cooking characteristics of aerobic rice genotypes

Genotype	Cooking time (min.)	Aroma	Percent increase in weight	Percent increase in volume	Water uptake ratio	Length (cm)	Breadth (cm)	L/B	Kernel elongation ratio	Percent curled grains	Dispersed solids (%)
IRRI 6	16	Faint	181.5	260	33.28	0.89	0.3	2.96	1.37	50	3
IRRI 14	16	Faint	210	233	35.65	0.93	0.29	3.2	1.44	35	4
IRRI 49	18	Faint	170	186	38.65	0.96	0.32	3	1.43	75	3.5
IRRI 259	23	Faint	173	244	39.1	0.88	0.3	2.93	1.3	49	3
IRRI 292	30	Faint	156	140	27.60	0.72	0.35	2.06	1.31	98	4
BI 27	17	Faint	195	230	35.5	0.87	0.31	2.8	1.44	36	2
BI 33	17	Faint	188	233	39.1	0.9	0.31	2.9	1.46	57	3
BI 43	17	Faint	192	233	39.70	0.87	0.31	2.8	1.44	41	3
BI 48	15	Faint	175	233	38.5	0.76	0.30	2.53	1.25	44	2.5
Motomutant	17	Faint	168	246	31.33	0.76	0.32	2.4	1.42	15	2
Doddaverunellu	32	Faint	136	100	25.9	0.75	0.37	2.03	1.35	99	4
Sonamansoori	15	Faint	240	290	39.65	0.79	0.28	2.82	1.55	10	2
F value	104.5*		2346*	909.1*	172.5*	203.9*	5.351*	49.3*	14.56*	226.9*	46.25*
SEm± (0.05)	1.0		0.88	8.08	0.405	0.0001	0.0003	0.008	0.001	10.5	0.038
CD (0.05)	5.78		25.5	48.1	4.71	0.078	0.03	0.37	0.09	27.5	0.76

* - Significant NS - Non-significant Sonamansoori - control

As shown in table 2, cooking time ranged between 15 to 32, percent increase in weight 136 to 210, percent increase in volume 100 to 260, water uptake ratio 25.9 to 39.7, and kernel elongation ratio 1.25 to 1.46. Significant difference was observed between the varieties for cooking characteristics like cooking time, percent increase in weight, percent increase in volume, water uptake ratio, length, breadth, L / B ratio, kernel elongation ratio, percent curled grains, and dispersed solids. A similar study was conducted by Hirannala et al (2001) and Chaubey et al (1988) who evaluated quality of rice on the basis of apparent water uptake ratio, L / B ratio and kernel elongation ratio. Harder gel consistency was associated with harder cooked rice and this feature was particularly evident in high amylase rice. Hard cooked rice tend o be less sticky .Gel consistency of milled rice or rice starch is found to be good measure of gel viscosity and an index of cooked rice texture.

Mean scores for selected sensory characteristics such as color, grain size, texture, taste and overall acceptability for raw and cooked rice samples of aerobic rice varieties are presented in Figure 2 & 3.

IRRI 14 had the highest sensory mean score for overall acceptability among aerobic varieties.

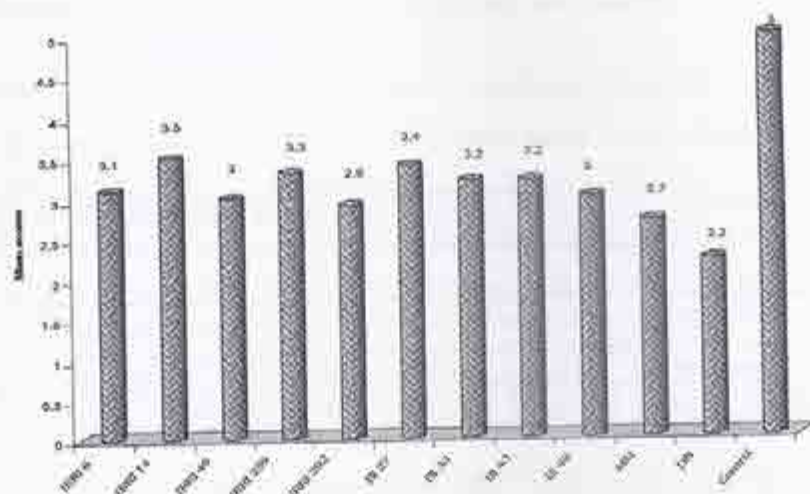


Fig 2: Mean sensory scores of aerobic rice genotypes

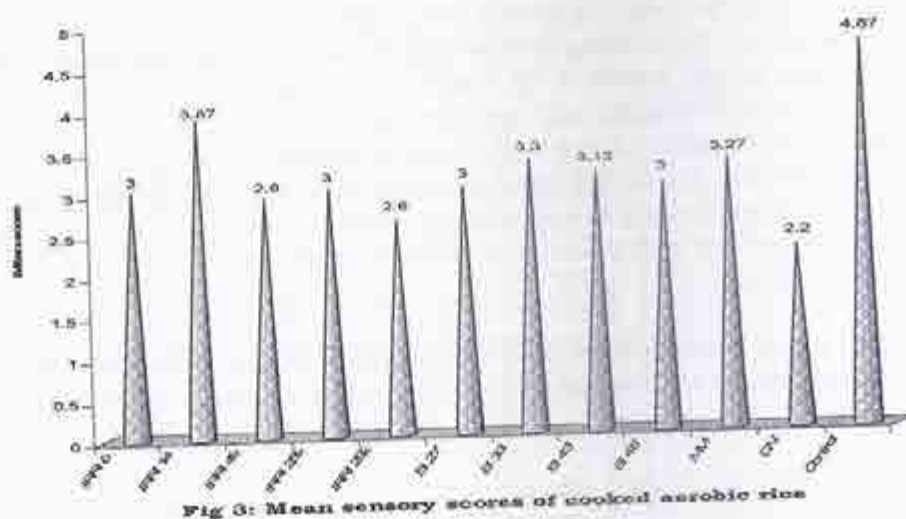


Fig 3: Mean sensory scores of cooked aerobic rice

Correlation between sensory mean score and cooking characteristics like percent increase in volume, water uptake ratio, length, L / B ratio, and kernel elongation ratio are presented in Table 3.

Table 3: Correlation coefficient of mean sensory scores with cooking characteristics

Cooking characteristics	Correlation coefficient (r)
Cooking time (min.)	- 0.389 ^{NS}
Percent increase in weight	0.397 ^{NS}
Percent increase in volume	0.798*
Water uptake ratio	0.893*
Length (cm)	0.894*
Breadth (cm)	- 0.785*
L / B	0.788*
Kernel elongation ratio	0.832*
Percent curled grains	- 0.795*
Dispersed solids (%)	- 0.777*

* Significant at 5 percent NS – non significant

Sensory quality of the cooked rice was positively correlated with the cooking characteristics like percent increase in volume, water uptake ratio, length, L / B ratio, and kernel elongation ratio whereas negatively correlated with breadth, percent curled grains and dispersed solids. Similar study was conducted by Thayumanavan (1987) who assessed the cooking quality of forty rice varieties and found that cooking quality is correlated with the sensory quality. The acceptability scoring of cooked rice could be reliably predicted from the physico-chemical properties such as protein content, amylase content and grain elongation ratio of milled rice. The above data helps in classification of rice for table purpose as the consumers prefer slender, long and non sticky rice with good aroma and the other varieties can be suited more for the byproducts.

CONCLUSION

Rice is the main cereal grown and consumed in India. With increase in water scarcity for farm use aerobic rice varieties will be a better option. There were significant differences between the aerobic rice varieties for most of the characteristics like milling, physical and cooking characteristics. Physical, chemical and nutritional characteristics do not explain all the elusive quality of rice cooking and processing. Therefore classification of aerobic rice in to various groups by sensory evaluation is a must to find a suitable end use. Many rice varieties high in nutritional quality are commonly not accepted for table purpose. So these varieties can be used in the form of processed products.

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DEVELOPMENT OF ENTERAL FORMULATIONS – AN ENTERPRISE

Dhruvi Bal and Kamal G. Nath
Dept. of Food Science and Nutrition
UAS, GKVK, Bengaluru – 560 065

Nutrition support has become an important therapeutic intervention for improving outcomes in hospitalized patients. Not only does diet determine disease, but also, disease can be modulated by diet. This understanding of nutrient effects on disease processes has led to the development of specialized nutritional formulas. Two such immune enhancing formulations from natural sources were developed and assessed for their physico-chemical, nutritional, nutrient bioavailability, storage behaviour along with the economics of the formulations and nutrition labeling. Primary sources of protein were soy protein isolate (SPI) and whey protein concentrate (WPC). The cost of enteral formulations was Rs. 19/- and Rs. 18/- for SPI and WPC formulations respectively. The formulations developed in the present study with natural sources of antioxidants and immunonutrients from tomatoes, carrots, amaranth greens (*Celosia argentea*), fish oil, whey protein concentrate and soyprotein isolate are expected to enhance the immune status when fed to the immunocompromised patients such as cancer, pre and post surgery, burns, HIV-AIDS, underweight, undernourished, febrile conditions, etc. The comparatively lower cost of the formulation will ensure its affordability by all classes of people. The enteral formulations developed in the present study could be considered for commercial exploitation as an income generating activity by the women of Self Help Groups.

KEY WORDS: Enteral formulation, immune enhancing, enterprise, self help groups, soy protein isolate, whey protein concentrate.

The term 'Immunonutrition' has been coined to describe diets that are specifically designed to enhance immune function. In recent years, nutrition and immunology are becoming interrelated disciplines and several nutrients have been shown to influence immunologic and inflammatory responses in humans (Singh et al., 2002). These specific nutrients that could influence and alter the immune status of the body are called as 'immunonutrients'. Most commonly used immunonutrient mixture contains n-3 fatty acids, conditionally essential amino acids arginine, glutamine, cysteine, taurine, nucleic acids and antioxidants.

Generally these immune enhancing enteral foods are prepared by blending chemically defined ingredients such as maltodextrin, casein, β -carotene, hydrolyzed starch, amino acids/hydrolyzed proteins like arginine, glutamine, nucleotides, L-carnitine, taurine, fortified with essential macro-micronutrients. These commercially available immune enhancing enteral foods are developed with a known and constant composition intended to provide immune boosting effects but on the contrary they are very costly and out of reach for general population considering the economic conditions of Indian patients. This calls for the formulation of immune enhancing enteral formulation made from natural sources with desired physico-chemical properties which would have a lower cost and also provide as an income generating activity for SHG women.

Very few efforts have been made to develop immune enhancing enteral formulations with known immunonutrients which will help in boosting the immune response, thus leading to faster recovery and shortened length of hospital stay. The present study was thus undertaken to develop such immune enhancing formulations from natural sources and to evaluate their physico-chemical, nutritional, nutrient bioavailability and storage characteristics along with a lowering down of the cost.

METHODOLOGY

Two enteral food formulations were developed based on the primary source of protein namely soy protein isolate (SPI) formulation and whey protein concentrate (WPC) formulation (Table 1).

Procurement of ingredients: Ingredients namely finger millet (*Eleusine coracana*), carrot (*Daucus carota*), tomato (*Lycopersicon esculentum*), amaranth greens (*Celosia argentea*), cod liver oil, groundnut (*Arachis hypogaea*) oil and sugar were procured from the local market. SPI was supplied by Solae company, Gurgaon and whey protein concentrate by Mahaan Proteins, New Delhi.

Fig. 1, 2 and 3 indicates processing of various ingredients

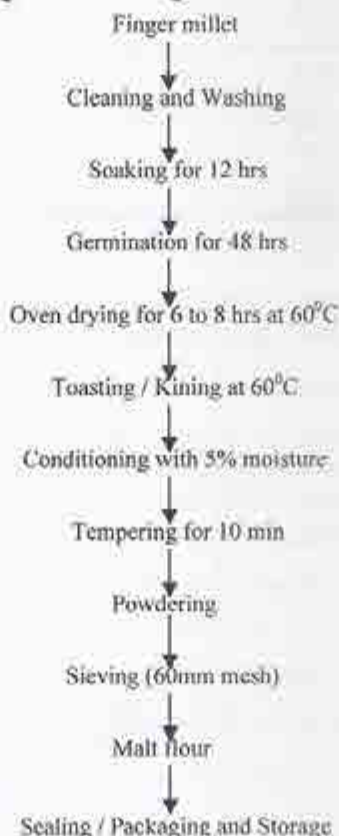


Fig. 1 Processing of finger millet

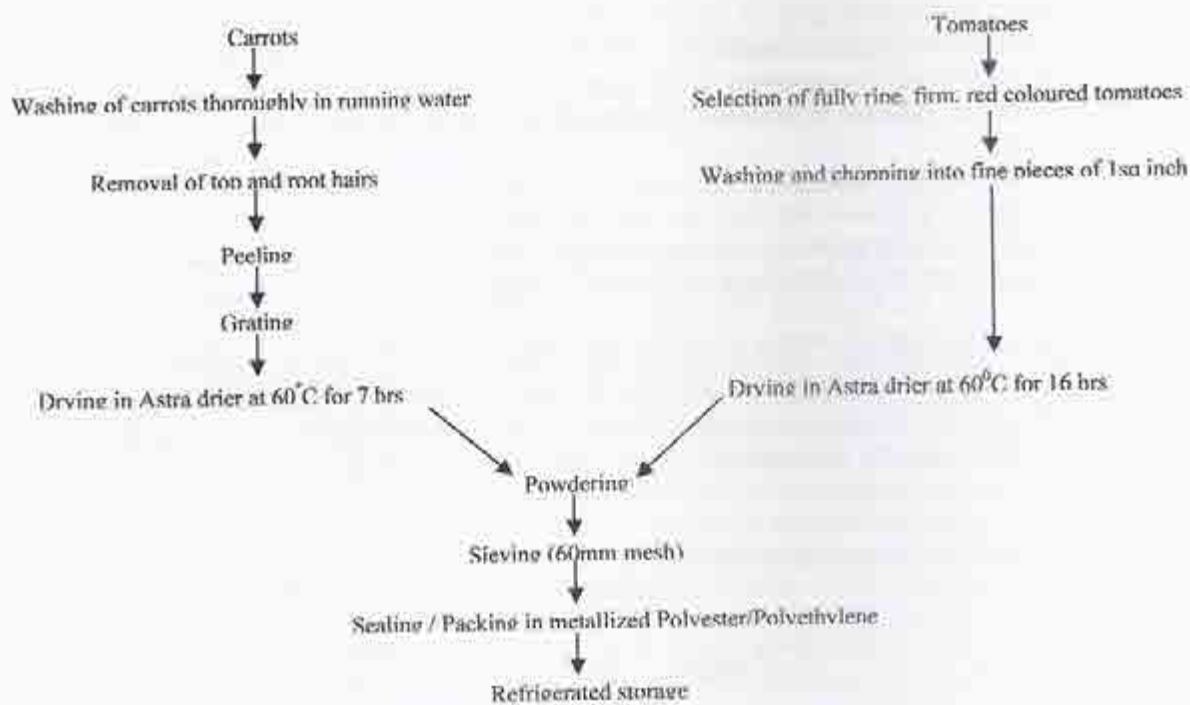


Fig. 2 Dehydration of carrot and tomatoes

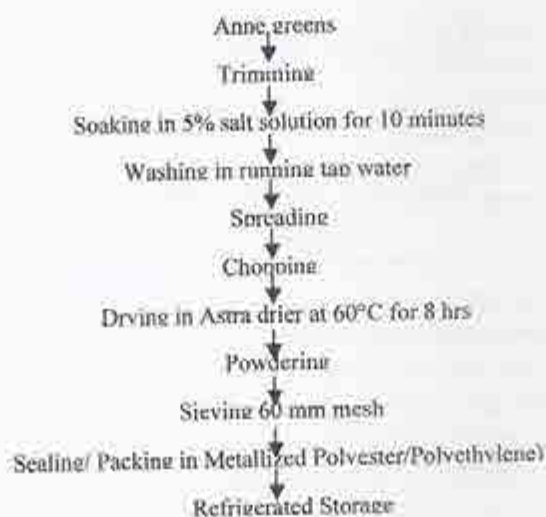
Fig. 3 Dehydration of Anne greens (*Celosia argentea*)

Table 1: Composition of enteral formulations

Ingredients	Soy Protein Isolate (SPI) formulation (gm)	Whey Protein Concentrate (WPC) Formulation (gm)
Finger millet (<i>Eleusine coracana</i>)	26.00	21.50
SPI	17.00	-
WPC	-	21.50
Fish oil	2.50	2.50
Groundnut oil	2.50	2.50
Tomatoes (<i>Daucus carota</i>) powder	9.70	9.70
Carrot (<i>Lycopersicon esculentum</i>) powder	3.80	3.80
Amr greens (<i>Celosia argentea</i>) powder	2.50	2.50
Sugar	36.00	36.00

All the ingredients were mixed in a planetary mixer for 15 min in fixed proportions along with vitamin and mineral premix to meet RDA (Gopalan et al., 2000) Table 2.

Functional properties

The two formulations were subjected to assessment of functional properties namely: Bulk density (Narayana and Rao, 1982), water and oil absorption capacity (Rosario and Flores, 1981), solubility and swelling power (Iyer and Singh, 1997), emulsification value (Sathe and Salunkhe, 1981) using standard procedures.

Organoleptic evaluation: (Pigotte, 1984)

The two enteral formulations developed were evaluated for their organoleptic properties by a taste panel of ten semi-trained judges for colour, body, flavor, aroma and overall acceptability by using a score card on a 9 point hedonic scale.

Table 2: Vitamin Mineral Premix

Ingredients	100% RDA	Qty/1.23g of premix	Qty µg/100g of premix
Vitamin B ₁	1.2 mg	0.001	0.0975
Vitamin B ₂	1.4 mg	0.001	0.1138
Vitamin C	40 mg	0.040	3.2520
Vitamin B ₃	16 mg	0.016	1.3008
Vitamin B ₆	2 mg	0.002	0.1626
Vitamin B ₁₂	1 mcg	0.001	0.0001
Folic acid	100 mcg	0.001	0.0081
Calcium (Calcium carbonate)	400 mg	0.999	81.2195
Iron (Ferrous sulphate)	28 mg	0.139	11.3333
Zinc (Zinc oxide)	15 mg	0.018	1.5178
Dextrose	-	0.012	0.9942
TOTAL	-	1.230	100

Rate of addition – 1.23 g of premix per 100 g of formulation

RESULTS AND DISCUSSION

Functional properties of foods denote any physico-chemical property, which affects the processing and ingredients in a food system, as judged by the quality attributes of the final product. The term 'functionality' as applied to food ingredients is defined as any property apart from any nutritional attributes that influences the usefulness of ingredients in a food system. Most functional properties affect sensory characters of food but can also play a major role in the physical behaviour of foods or food ingredients during their preparation, processing and proteins contribute significantly to the physical properties of foodstuffs.

The functional properties of the enteral formulations are presented in Table 3. The functional properties presented are bulk density, water absorption capacity, fat absorption capacity, specific gravity, emulsification value and swelling power. The SPI formulation had a higher bulk density (0.61 g/ml) than the WPC formulation (0.55 g/ml). The water binding capacity is an important function of protein in foods. The WPC formulation had a comparatively higher fat absorption capacity (1.1 ml/g) than the SPI formulation (1.0 ml/g). This fat absorption capacity has been attributed to the physical entrapment of oil. This property is important, since fat acts as flavour retainers and increase the mouth feel of the foods. Due to the higher water absorption capacity of

the SPI formulation it also has a higher swelling power (3.74 g/g) in comparison to the WPC formulation (3.16 g/g).

Table 3 : Functional properties of the enteral formulations

Formulation	Bulk density (g/dl)	Water absorption capacity (ml/g)	Fat absorption capacity (ml/g)	Specific gravity	Emulsification value (ml/g)	Swelling power (g/g)
Soyprotein isolate	0.61	1.36	1.00	1.02	0.96	3.74
Whey protein concentrate	0.55	0.83	1.10	1.02	0.53	3.16

Note: Values are average of triplicates

Organoleptic evaluation of the enteral formulations

The standardized enteral formulation (SPI and WPC) were subjected to organoleptic evaluation after reconstitution. The same were evaluated for their colour, flavour, aroma, body/consistency and overall acceptability on a nine point hedonic scale by a panel of ten semi-trained panelists. The results of the same are presented in Table 4. The scores of organoleptic evaluation ranged from 7 to 8 (from like very much to like extremely). For the quality attributes, the mean score for colour was higher (7.7) for the WPC formulation than the SPI formulation (7.5) though statistically non-significant. Mean scores for body/consistency, aroma and over all acceptability of the SPI formulation was higher than that of the WPC formulation. No significant differences were observed in the sensory scores between the two formulations indicating that the formulations were equally acceptable.

Table 4 : Mean sensory scores of enteral food formulation

Sensory parameters	Colour		Body /Consistency		Flavour and aroma		Overall acceptability	
	SPI	WPC	SPI	WPC	SPI	WPC	SPI	WPC
Sensory scores	7.5	7.7	7.7	7.5	7.2	7.0	7.5	7.3
F-value	0.34		0.42		0.23		0.42	
SEm±	0.24		0.21		0.29		0.21	

Note: All the values are non-significant

SPI – Soy protein isolate formulation

WPC – Whey protein concentrate formulation

Economics of production of enteral formulations and nutritional labeling

In certain disease conditions the immunity status is compromised such as burns, surgery, cancer, HIV-AIDS, trauma etc. which affects all the socio-economic classes of the population. The population in the higher socio-economic class have better purchasing power and hence can go in for expensive pharmaceutical preparations/formulations. However, the population belonging to lower socio-economic category have lower purchasing power with low affordability for these preparations/formulations. It is imperative, that the certain enteral formulations be developed for this category of population. Immunocompromised conditions such as HIV being highly prevalent among the lower economic strata of the population, daily consumption of those low cost enteral formulations would go a long way in improving their immunity status as well as improving their quality of life.

Dehydration of vegetables

The cost calculation for the production of tomato, carrot and amaranth greens (*Celosia argentea*) powder is presented in Table 5. The dehydration of the vegetables was carried out using an Astra drier (biomass dehydrator). The Astra drier used in the present study has been developed by Centre for Sustainable Technologies, Indian Institute of Science, Bangalore. This drier uses biomass (wood, dry leaves, paddy husk etc.) as source of energy for dehydration rather than electricity, as used by the commercial driers, the use of biomass will help to bring down the cost of the final dehydrated product.

The biomass is ignited externally in the Astra drier and the heat circulates throughout the drier. The temperature is recorded at regular intervals with the help of a digital thermometer which is attached to the trays of the drier through probes. The cost of installation of an Astra drier is around approx. Rs. 40,000.00.

The calculated cost of the tomato powder, carrot powder and amaranth (*Celosia argentea*) greens powder was Rs. 27.50 and 14.70 per 100g respectively. The cost analysis of dehydrated tomato powder was carried out by Gupta et al. (2006). An aeration Astra drier was used for drying. The drying cost was Rs. 1.23 per kg of fresh tomatoes. This was for a batch of 15-30kg of tomato and included labour costs (0.80) blanching (Rs. 0.02), electricity and miscellaneous (Rs. 0.41).

The cost calculation for 100g of the enteral formulation is presented in Table 6. The following components have been included along with the cost of ingredients used in the formulations. Labour was calculated at Rs. 60/8 hrs, electricity Rs. 5.60/unit/hour and packaging material Rs. 40/100 to ensure a better shelf life. The cost per unit pack was Rs. 19.00 for the SPI formulation and Rs. 18.00 for the WPC formulation.

Joshi and Jain (2005) developed a ready to reconstitute enteral mix, the cost of mix was Rs. 23.50 for 355 g of mix which meets a day's requirement. This cost included the cost of raw material and 20 % processing charges.

Table 5: Economics of manufacture of dehydrated vegetable powder.

Components	Cost (Rs.)
57 kg of tomato at Rs. 4/kg	228.00
Drying – fuel (wood) – 24.5kg at Rs. 2/kg	049.00
Powdering – 30 min, @ Rs. 5.60/unit/hr Rs. 2.30	002.30
Labor cost – 24 hrs, @ Rs. 60/g	180.00
1700 g dry powder from 57 kg of fresh tomatoes	
Cost of 1700 g of tomato powder	460.00
Cost of 100 g powder	027.00
35 kg carrots @ Rs. 10/kg	350.00
Drying – fuel (wood) – 10.5kg at Rs. 2/kg	021.00
Labour cost – 12 hrs, @ Rs. 60/8 hrs	090.00
Grating and powdering – 2 hrs, @ Rs. 5.60/unit/hr	011.20
2200 g dry powder from 35 kg of carrots	
Cost of 2200 g of carrot powder	473.00
Cost of 100 g dry powder	021.50
10 kg of fresh greens	010.00
Drying – 12 hrs, @ Rs. 5.60/unit/hr	067.20
Powdering – 15 min, @ Rs. 5.60/unit/hr	001.40
Labor – 8 hrs, @ Rs. 50/8 hrs	050.00
1500 g dry powder obtained from 10 kg of fresh greens	
Cost of 1500 g of greens powder	022.00
Cost of 100 g dry powder	014.70

Table 6: Economics of enteral formulations.

Ingredients	Cost of ingredients	SPI formulation (100 g)	WPC formulation (100 g)
Finger millet	Rs. 10/kg	Rs. 0.30	Rs. 0.30
Soy protein isolate	Rs. 30/100 g	Rs. 5.10	-
Whey protein concentrate	Rs. 20/100 g	-	Rs. 4.30
Fish oil	Rs. 107.80/100 g	Rs. 2.70	Rs. 2.70
Groundnut oil	Rs. 6.70/100 g	Rs. 0.20	Rs. 0.20
Carrot powder	Rs. 21.50/100 g	Rs. 8.0	Rs. 0.80
Tomato powder	Rs. 27.00/100 g	Rs. 2.60	Rs. 2.60
Anne greens powder	Rs. 14.70/100 g	Rs. 0.40	0.40
Sugar	Rs. 20/kg	Rs. 0.70	Rs. 0.70
Labour	Rs. 60/8 hrs	0.30 p	0.30 p
Fuel	Rs. 5.60/unit/hour	0.10 p	0.10 p
Packaging material	Rs. 40/100 packs	Rs. 0.40	Rs. 0.40
Over head charges	40% of total expenses	Rs. 5.40	Rs. 5.10
Cost per unit pack (100g)		Rs. 19.00	Rs. 18.00

Enteral formulation – An enterprise

Biomass dehydrator was used for the dehydration of the vegetables. Manufacture of dehydrated vegetable powder can be taken up as an entrepreneurial activity for women of self help groups. It can be recommended by the hospitals and other organizations to feed the immunocompromised patients such as cancer, HIV-AIDS, burns, pre and post surgery, febrile conditions, under weight etc. However, utmost care should be taken in the hygienic preparation of such products.

Nutritional labeling

The label developed for the two enteral formulations has been presented.

IMMU – AID A DIETARY SUPPLEMENT	
Supplement Facts Serving Size – 2 glasses	
	Amount per serving (50 g)
Calories	202 kcal
Total Fat	2.67 g
Protein	8.75 g
Calcium	125 mg
Iron	5.22 mg
Magnesium	50 mg
Zinc	3.45 mg
Copper	1.75 mg
Lycopene	1.75 mg
Omega 3 Fatty Acids	
EPA	50 mg
DHA	450 mg
β-Carotene	2832 µg
Ingredients: Ragi, Whey protein concentrate (WPC), tomato, carrot, anne greens, fish oil, Vegetable oil, sucrose.	
Immu – Aid is a scientifically formulated dietary supplement. Immu - Aid with WPC as source of proteins, supplies essential aminoacids, lycopene, Beta carotene and omega-3 fatty acids which act as anti oxidants and help in enhancing the immune system.	
Directions for use: Cut open the sachet, add half cup (100ml) water to make a smooth paste and add up to 1.5 cups (300 ml) of boiling water, cook for 3-5 minutes with continuous stirring.	

IMMU - AID
A DIETARY SUPPLEMENT

Supplement Facts

Serving Size – 2 glasses

	Amount per serving (50 g)
Calories	201 kcal
Total Fat	2.58 g
Protein	8.5 g
Calcium	165 mg
Iron	5.02 mg
Magnesium	85 mg
Zinc	2.5 mg
Copper	1.15 mg
Lycopene	1.60 mg
Omega 3 Fatty Acids	
EPA	60 mg
DHA	375 mg
β-Carotene	2876 µg

Ingredients:

Ragi, Soyprotein isolate (SPI), tomato, carrot, anne greens, fish oil, Vegetable oil, sucrose.

Immu – Aid is a scientifically formulated dietary supplement. Immu - Aid with SPI as source of proteins, supplies essential aminoacids, lycopene, Beta carotene and omega-3 fatty acids which act as anti oxidants and help in enhancing the immune system.

Directions for use:

Cut open the sachet, add half cup (100ml) water to make a smooth paste and add up to 1.5 cups (300 ml) of boiling water, cook for 3-5 minutes with continuous stirring.

CONCLUSION

The enteral formulations developed in the present study with natural sources of antioxidants and immunonutrients derived from tomatoes, carrots, amaranth greens (*Celosia argentea*), fish oil, whey protein concentrate and soyprotein isolate is expected to enhance the immune status when fed to the immunocompromised patients such as cancer, pre and post surgery, burns, HIV-AIDS, under weight, undernourished, febrile conditions, etc. The comparatively lower cost of the formulation will ensure its affordability by all classes of people.

The enteral formulations developed could be considered for commercial exploitation as an income generating activity by the women of Self Help Groups.

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IMPACT OF TEACHING LEARNING AND COMMUNITY PARTICIPATION IN SAMUDAYIK JANSHALAS IN JAIPUR CITY

Ruby Jain* and Shikha Jain

Assistant Professor, Department of Home Science
University of Rajasthan, Jaipur

In spite of lot of efforts made to improve the literacy rate, the scenario of literacy especially of women in Rajasthan is very gloomy. A number of programmes have been initiated to improve the literacy rate, but special attention to girls and marginalized population of urban slums was only addressed in 'Janshala Programme'. The present paper explores the 'Teaching Learning Situation' and 'Community Participation' and depicts the impact of these on enrolment and retention of the children. Information was withdrawn from Children, teachers and parents involved in Janshalas through Focussed Group Discussion, Questionnaire and Observation Method along with Secondary data. Results show that teachers were highly competent and involved with children and community, children were comfortable and had developed interest in studies whereas parents who were illiterate have realized the importance of schooling and were ready to send their wards to schools in future except a very small percentage who still felt that the girl child should be restricted to home. The increase in the enrolment, decrease in the dropout rate and upward trend in mainstreaming of children in government schools all show the impact of these alternative schools.

KEY WORDS: Teaching Learning, Community Participation, Rajkiya Janshala, Samudayik Janshala, Mainstreaming.

Education is one of the most important drivers of India's social and economic development. Higher levels of literacy leads to greater economic output, higher employment levels, better health, better social structures and higher outcomes along a number of other developmental indicators. More specifically, the impact of educating girls and women has been shown to result in rapid improvements in family planning, nutrition, health, and income (Posed, 2009). Hence, education is seen as one of the best tools for promoting social and economic development.

India ranks 134 in Human Development Index in the latest Human Development Report by United Nations Development Programme (Human Development Report, 2009). In terms of literacy only 66% of India's population over the age of 15 is literate and only 61% children are in school. A rapid stride in this field is the demand of the day. In Rajasthan male literacy rate has increased from 13.88% in 1951 census to 76.46% in 2001 census and female literacy rate from 2.66% in 1951 to 44.34% in 2001 census. These are not very promising figures, especially the female literacy rate and one has to go a long way. In Rajasthan a large number of programmes have been initiated to promote literacy. These are Non Formal Education Programme which was initiated in 1978 for 6-11 years, Shiksha Karmi Project implemented since 1987 for primary school children, Lok Jumbish Project initiated in 1992 focused on primary education, Saraswati Yojna launched in 1994 aimed at primary education to girls in rural areas by local educated

women, District Primary Education Programme started in 1999 for primary school and Gurumitra Yojna initiated in the year 1994 focused on girls.

One such programme is the **Janshala Programme**, which is a joint Government of India (GOI) and United Nation (UN) community based primary education programme. Janshala was the first ever programme in the world where five UN agencies had collaborated and committed resources to support an initiative in the primary education. UNDP, UNICEF and UNFPA committed and contributed US \$20 million as grant for the programme, UNESCO and ILO offered technical support. It was the first effort made for urban slums as the growth of urban slums is accelerating.

There are four components of the Janshala Programme:

1. Rajkiya Janshala (RJS) (Primary and Upper Primary Government School)
2. Samudayik Janshala (SJS)
3. Bridge Course
4. Early Child Care and Education (ECCE)

The concept of Samudayik Janshala emerged from the grass root realities that there were areas within the city, mostly slums, which had no access to primary education for their children. It aims at making elementary education increasingly accessible and effective for deprived children between 6-14 years of age in urban slums across the state. Samudayik Janshalas (SJS) were alternative learning centres based on effective yet joyful teaching process and community participation for the holistic development of children. Later these children can be mainstreamed in primary and upper primary government schools. Teaching learning and community participation play a vital role in such alternative centres.

Leagans (1961) stated that an effective learning situation consists of five essential elements: Instructor, Subject matter, Physical facilities, Teaching material and Learner. There is a constant reaction by learners to each of the other four elements in the learning situation. Talton and Simpson, (1987) argued that the achievement motivation develops in a stimulating environment. Kalyani, (2002) revealed that the environmental opportunities provided to children play a major role in improving the intellect of children. A total of everything in school that is teacher, learner, subject matter, teaching material and physical facilities and their interaction comprises a child's environment. A study of the teaching learning environment therefore involves an evaluation of all these aspects of the study environment.

Community participation is a process in which people express themselves, share, contribute and act with mutual responsibility to promote a common interest. Studies done by Wilson, (1997) and Prasad and Rajeshwar (1999) have shown enhanced success when schools functioned with participatory management. This research study was carried out to understand the impact of the teaching learning situation and community participation in SJS on the ultimate beneficiary- the child. This in turn was assessed through:

(i) Examining Teaching learning situation in SJS through:

- a) Physical facilities in SJS
- b) Teacher's profile
- c) Teaching process
- d) Learner's feedback

(ii) Community support and participation

(iii) Evaluating the success of the SJS

- a) Parental feedback
- b) Enrolment and retention of the children.

METHODOLOGY

The study was conducted in the schools (Samudayik Janshalas) of city slums of Jaipur District of Rajasthan. The SJS programme was being implemented in six zones of Jaipur District with a total of 107 SJS. Out of these, 11 SJS were selected through systematic random sampling. Since the study was about the teaching learning situation, community support and participation the information was collected from the students, teachers and parents. At each SJS, 10% of the total enrolled students were selected from the attendance records through systematic random sampling. Thus, from 11 SJS, the total of 112 students and 25 teachers who were present at the time of survey were selected to collect the information. One hundred parents were chosen from 11 SJS through purposive accidental sampling.

To assess the physical facilities, direct observation method was used using a check list containing 9 items viz. sitting area, sitting arrangement, room space, cleanliness, light, ventilation, drinking water facility, toilet facility and distraction. These items were rated on 5 point likert scale where 5 stands for excellent, 4, 3, 2, 1, for good, fair, poor and very poor respectively.

Teachers profile was collected through semi- structured questionnaire with teachers. Items covered were age, sex, education, reasons for teaching and details of teaching. Results are reported in percentages where ever possible. Teaching process was assessed through questionnaire administered to teachers along with direct observation and secondary data also. The process parameters covered were maintaining attendance record, following prescribed syllabus, teaching method, teaching learning material (TLM), home assignment, students' evaluation, management of students, extracurricular activities and supervisory visits. Descriptive statistics in the form of percentages was used where ever possible.

Learners feedback was recorded through focussed group discussion (FGD). A total of eleven FGD's were conducted with students one at each center, the group size was 10-12 students. The researcher was trained to conduct FGD along with a moderator and a recorder. Topics covered were teacher and teaching method, children's daily routine, suitability of time and place for working children, motivation to come to school and their future aspirations. All these parameters were adequately probed.

Information was drawn from teachers through questionnaire method on Community support and participation. Items covered were interaction with parents, approaching them and kind of support offered by parents and community. For evaluating the success of SJS parental feedback and enrolment and retention of children were recorded. Parent's feedback was drawn through a questionnaire filled by an interview method by the investigator on items related to school, child's behaviour and their opinion. To collect information related to enrolment, dropout and mainstreaming secondary sources like admission registers, attendance registers, result and transfer records were analysed.

RESULTS AND DISCUSSIONS

All the paradigms of teaching learning and community support and participation were investigated and the data collected was analysed in the light of objectives. Finally the impact of these two was assessed by evaluating its success through parental feed back and enrolment and retention of the children.

(i) Teaching learning situation

(a) Physical Facilities

The investigator herself visited all 11 centers without any previous information to the teachers for assessing physical environment. Mean scores for the items such as sitting arrangement, cleanliness, light, ventilation, drinking water facility, room space are between 4 to 5, hence were up to the mark (Table 1).

Table1: Assessment of physical facility

S.N.	Item	Mean score
1	Sitting area	3.3
2	Sitting arrangement	4.2
3	Room space	4.2
4	Cleanliness	4.0
5	Light	4.5
6	Ventilation	4.3
7	Drinking water facility	4.5
8	Toilet facility	1.5
9	Distraction	2.3

N=11 SJS

It was noticed that in eight schools sitting area was in shed and in three it was in open. Six schools had a lot of distraction (Mean score - 2.3) where younger siblings accompanied the students. Younger siblings were the major source of distraction as the girls had to take care of them in the schools. Seven of the schools did not have any toilet facility so children use to go out in the open and in other four centers the toilets did not have doors and water facility (Mean score - 1.5). This needed immediate attention since these SJS focused primarily to capture girls of urban slums and it was found in previous studies that the retention in school is positively correlated to adequate toilet facilities. This demands the intervention of Total School Sanitation

(i) Examining Teaching learning situation in SJS through:

- a) Physical facilities in SJS
- b) Teacher's profile
- c) Teaching process
- d) Learner's feedback

(ii) Community support and participation

(iii) Evaluating the success of the SJS

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Programme for developing toilet facilities. The most important point to note is that the school space is a result of the efforts made by the community.

(b) Teacher's Profile

Another important paradigm of teaching learning situation is the "teacher". Results showed that 70% of them were females and 30% were males, 73% having graduation and remaining 23% possessed post graduation degrees. 50% of them were in teaching job since this adds to their income. The rest of the teachers joined it as a social work (40%) and to use their free time (10%).

All the teachers have undergone rigorous training of 40 days under Bodh Shiksha Samiti (An NGO which was the technical support group (TSG) of Janshala programme in Rajasthan) prior to teaching in SJS. Teachers were trained to use activity based teaching methodology under Multi Grade Approach where learning is seen as a continuum and is not compartmentalized into class wise content areas. Regular training at monthly intervals was also imparted during teaching. These trainings had a lot of utility since it makes the teaching "child centred" and teachers also learn to make relevant teaching learning materials (TLM's). National Policy on Education (1986) propagates the teaching to be "child centred". NPE updated in 1992 emphasized teacher education as a continuous process, its pre-service and in service components being inseparable. Various authors like Daresh (1987) put forth that the staff development and in-service education is viewed as effective when it is a part of training that continues over an extended period of time. Yadav (2000) found the gains of training to be significant.

(c) Teaching Process

The data in table- 2 shows that all the teachers (100%) take the attendance of the students regularly. All the teachers followed a prescribed syllabus consisting of 10 units. No book is prescribed at the initial stage. Methods used for teaching were balgeet, poems, stories, games, pictures etc. Though the teaching learning materials (TLM's) were available through zone coordinators, many teachers themselves made the TLM's. Hence the training imparted to them developed their capacity and they were fully equipped to develop their own material.

The study revealed that majority of teachers (80%) gave very less homework to the students and 20% teachers did not give any homework. Evaluation of student's performance is carried out monthly, half yearly and annually at all SJS, through both oral and written tests. There was consistency in results shown at all the SJS. The study also revealed that the extra curricular activities were organized in all SJS from time to time. Besides celebrating national festivals regional festivals were also celebrated to attract and motivate children. Hence, the teaching process in SJS was very effective and child centred drawing children towards SJS. This was in line with NPE (1986) that advocated, "a child centred and activity based process of learning" to educate the school going child. The data showed that surprise visits were made at all SJS by NGO coordinators.

Table 2: Teaching process parameters

S.N.	Teaching process parameter	Number of Responses (percentage)
1	Maintaining attendance records	25(100%)
2	Following prescribed syllabus	25 (100%)
3	Teaching method (games, songs, stories, pictures, poem etc)	20 (80%)
4	Teaching learning material- self made (charts, posters, flash cards etc)	18 (72%)
5	Home assignment	20 (80%)
6	Student evaluation (Oral and written test)	25 (100%)
7	Management of students (multi grade approach)	25(100%)
8	Extra curricular activities(mehandi, rangoli, slogan writing, drawing, dance, puppet shows, celebration of national festival)	22(88%)
9	Supervisory visits	25 (100%)
10	Adequacy of teachers	21 (84%)

N =25

(d) Learner's feedback

Our discussion on teaching learning process would be incomplete without knowing the most important element - the learner. Focussed group discussions (FGD) were conducted with a group of students at each SJS. During the discussions they reiterated the fact that teaching in SJS is through charts, posters, cards, play equipment, games, songs, poems etc, which attract the children in SJS. The children spoke freely and shared their views without any hesitation with the investigator. They told that the teachers teach with love and affection without any kind of punishment. In the words of students *"Here we play and sing songs along with studies"* (Rekha from Chipiwada Centre). *"Here Didi teaches nicely. She sits next to me and make me understand. If I do something wrong she does not scold"* (Kailash from Rajiv-Nagar Centre). School timings and place was decided with the help of community so all children including the working ones had access to it. Even Children had the confident look on their faces and had a feeling of being at home as observed by the investigator. They aspired to become Doctor and teacher in their future and wished to continue their studies. With the help of the information collected, one can conclude that the teaching environment in SJS is very conducive for the learning to take place. Students in focused group discussions verified the information given by the teachers in their questionnaire schedule and further observation was done when actual teaching was going on at SJS.

(ii) Community support and participation

Any educational programme's success can be judged with the quality of community support and participation. This was investigated with the help of questionnaire for teachers and interviews with the community. All teachers reported to have interaction with the parents and community for one hour daily and discussed issues related to school, education of children, health and hygiene etc. 100% teachers agreed that approaching community people was not difficult in their areas and the community contributed in all respects, not only in the form of giving place for the school to

operate, but also in the form of cash for purchasing durries, brooms, earthen pot to store water. Items like table fan and ceiling fan were donated, they also came forward and made cemented place to keep water pot and clean and mop the floor. In this direction Santhanam et al., (1982) found that participation would emerge only when the people for whom the programmes are meant are consulted from the very first stage of need identification. In the case of Samudayik Janshalas the community was given due importance right from the very first stage.

(iii)Evaluating the success of SJS

To evaluate the success of SJS Parental feedback and Enrolment and retention of children was analysed.

(a)Parental feedback

Data in table (3) reveals that 95% of the parents send their children regularly to SJS. 100% of the parents reported that teachers in SJS come regularly and were satisfied with the teaching in SJS. The majority of the parents (70%) expressed that the children share their experiences with them after coming from school. Eighty five per cent parents said that their children repeat the lessons at home and the parents have observed drastic change in their attitude, they are well behaved, don't use abusive language, do not waste their time and keep themselves clean. All the parents have realized the importance of the education and 95% of parents are determined to continue the studies. Still 5% of the parents felt that their girl child should perform household duties. Prasad and Rajeshwar (1998-99) found that when innovative approaches to primary education in a tribal area were introduced, the same schools, which were closed, started again along with the others. The main reason for this was the parent's involvement in the schools.

Table 3: Parental feedback

Items	Number of responses	
	Yes	No
School		
Children are regular	95	5
Teachers are regular	100	-
Satisfied with SJS	100	-
Child's behaviour		
Children share experience	70	30
Children repeat lesson at home	85	15
Positive change in behaviour	80	20
Opinion		
Feels education necessary	100	-
Continue child's education	95	5
After studying future life will be better	95	5

(b) Enrolment and retention of children

The data was obtained from the attendance records and other records from all eleven SJS. Table (4) shows the enrolment, dropouts and mainstreamed children in the second year after the start of the programme. The teachers reported that around 80% of the enrolled students come regularly.

The child friendly environment and joyful methods of teaching have not only drawn children to the schools but also encouraged the parents to ensure their regular attendance.

Table 4: Enrolment, dropout and mainstreamed children in selected SJS

SELECTED SJS	ENROLMENT			DROPOUT			MAINSTREAMED INTO SCHOOL GOVT.		
	Boy	Girl	Total	Boy	Girl	Total	Boy	Girl	Total
Jawahar Nagar 7(a)	25	31	56	3	5	8	11	10	21(37%)
Jawahar Nagar 7(b)	18	26	44	3	5	8	3	4	7(16%)
Bandha Basti	40	60	100	2	1	3	5	5	10(10%)
Shahid Indira Jyoti nagar.	56	78	134	2	1	3	4	6	10(7.5%)
Ambedkar Colony	33	23	56	2	-	2	4	2	6(11%)
Rajiv Nagar	20	25	45	-	-	-	-	-	-
Mehnat Nagar	10	30	40	2	1	3	-	2	2(5%)
Vedpuri	45	56	101	2		2	1	2	3(3%)
Bhisiyo ka Mohallah	55	60	115			-	-	-	-
Fakiro ki Doongri	45	64	109	1	2	3	8	12	20(18%)
Chhipwada	38	64	102	3	5	8	5	10	15(15%)

Table 4 shows that the enrolment of girls stands higher to boys at all the centres except at Ambedkar colony. The reason behind this as reported by the girl students was that their brothers go to government schools and their parents do not want to send them far away from their houses. The other reason of not sending the girls seems to be the household chores for the female child. This can be seen clearly as the distraction to the students is mainly due to siblings who accompanied their sisters. The parents were ready to send the girl child to these alternative-learning centres but since they themselves work they wanted their female child to share their responsibility of rearing the younger ones. When the alternative schools were available in close vicinity parents started sending their girl child to them. Hence the location of the school was a determining factor in the enrolment. The number of dropout is less, however, the mainstreaming numbers were lower; one reason could be that in slum areas parents keep changing the place of stay. The main objective behind any programme is to increase the retention of children so that these children could be mainstreamed to the main schools (Rajkiya Janshala). If we observe the data closely we will see that at all the selected SJS the children were mainstreamed. Striking results can be seen at *Jawahar nagar (7-a)* where 37% of children mainstreamed. This is followed by *Fakiroo ki Doongri*, *Jawahar nagar (7-b)*, *Chhipwada*, *Ambedkar Colony* and *Bandha Basti* where the percentages of children mainstreamed were 18%, 16%, 15%, 11 and 10% respectively. Here if we see closely the mainstreaming number of girls is higher in many centres

Hence, the program could free the girl from the barriers of household task to the world of education, thus offering them schools in the vicinity of their residential areas. New and

innovative methods of teaching offered by trained teachers with the community support can help the girl child to become confident and independent. This in turn would help the country to combat the illiteracy problem.

CONCLUSION

If we take a comprehensive view of the teaching learning situation, community support & participation and enrolment & retention of Janshala programme, we get a clear picture that the two pillars of education - the teaching learning situation and community support and participation were very strong. The programme has been able to change the mindset of the parents for educating their girl child especially in a state like Rajasthan where female education has been ignored. The retention of the children even the girls in the school showed an upward trend, dropout rate was almost negligible and mainstreaming percentages were high thus it can be concluded that Janshala programme was a step towards the universalization of elementary education

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RELATIONSHIP BETWEEN CONSANGUINEOUS MARRIAGE AND HEALTH STATUS OF CHILDREN

Chandra Venkatasubramanian* and K.Siranjothi**

*Associate Professor and Head

**Research Scholar: Post Graduate Department of Home Science

Queen Mary's College, Chennai -4

55cmani@gmail.com*

Marriage is a social, religious, spiritual and legal union of two individuals. It is a contract and constitutionally and religiously correct. The act of marriage changes the personal and social status of the individual. Consanguinity refers to the property of being from the same lineage as another person. But there are compelling arguments on health grounds that it is not good to be consanguineously married as personal health and children's health are grossly affected. The dangers of marriage between first cousins are to be highlighted and the disability and disorders like hearing loss, anaemia, physical deformity and impairment of vision in children have been traced to their parents who have entered into first cousin consanguineous marriage. Purposive sampling technique was used and 75 each of consanguineous and non consanguineous married partners [married for a period of five years, spouses in the age range of 30 to 35 years] with children were selected from Chennai city. Raven's Progressive Matrices and RIAS were the two tests used to assess the cognitive ability of the children. From the above two tests it revealed that the cognitive abilities of children of Consanguineous partners were lower than those of Non consanguineous partners. Thus it can be concluded from the above study that the health status of children and mothers are affected. Education has an important role to play in this area. There appears a direct relationship between the degree of consanguinity and physical, mental and emotional health of the children.

Keywords: Consanguinity, Raven's Progressive Matrix, RIAS, health status.

INTRODUCTION

Marriage is a social, religious, spiritual and legal union of individuals. The act of marriage changes the personal and social status of the individual. Consanguinity refers to the property of being from the same lineage as another person. It is the quality of being descended from the same ancestor as another person. Parental consanguinity have more chances of bringing various ill-effects such as autosomal recessive conditions (Modell, 1991) and high risk of many disorders such as congenital heart disease, neurological malformation, chromosomal disorder and mental retardation (Jain et al., 1993). Health status is defined as the level of health of the individual, group, or population as assessed by the individual's anthropometry, clinical examination and performance on intelligence tests and progressive matrix tests. In Asian communities there is a prevalence of consanguineous first cousin marriages (Bittles and Neel, 1994). The likely effects of such unions on the health of the mother and child need to be studied.

The present study therefore focused on examining the relationship between consanguineous marriage and the health status of children by means of anthropometry, clinical examination and intelligence tests.

METHODS AND MATERIALS

A comparative study on health status of children of consanguineous and non-consanguineous partners was undertaken. Consanguinity describes a relationship between two people who share a common ancestor a 'Shared Blood' relationship (Bittles, 2005). The objectives of the study were to compare the physical, psychological and social well being of children and health status of mother from selected consanguineous and non-consanguineous partners. Ex-post facto research design was used for the study. Ex post facto research is a systematic empirical inquiry in which the scientist does not have direct control of the independent variable because their manifestation has already occurred or because they are inherently not manipulated (Gupta, 1993). Uni-variate research design, cross sectional in nature was used with independent variables such as consanguineous marriage, degree of relationship between the partners selected and the health status of children and the mother were the dependent variables. Degree of relationship is a measurement of kinship, and may generally be measured as either one vertical or horizontal step in a standard family tree. A first-degree relative is a family member who shares about 1/2 of their genes with a particular individual in a family. First degree relatives include parents, offspring, and siblings (Lister Hill National Center for Biomedical Communications, 2010). An uncle/aunt, niece/nephew or a grandparent is a second-degree relative and share 1/4 of their genes, and a first cousin, great-grand parents and great-grandchildren, is a third-degree relative and share 1/8 of their genes (FORCE: Facing Our Risk of Cancer Empowered, 2010).

Purposive sampling technique was used and 75 each of consanguineous and non consanguineous married partners [married for a period of five years, spouses in the age range of 30 to 35 years] were selected from Chennai city. The sample therefore consisted of 150 children of the selected 150 partners.

Questionnaire and interview schedule were the tools used for collecting data. The details regarding demographic profile, maternal health, health problems during pregnancy, health status of the children was collected. Social and cognitive assessment of the children was conducted. Secondary data like birth weights, respiratory rate, heart rate, sensory system and body movements were obtained from health records. Health problems of the children like mental retardation, deafness, dumbness, blindness, birth defects, diabetes, neurological malformation, epilepsy, speech problem and learning difficulties were gathered through an interview schedule.

Sociometric test was implemented to analyse the social behavior of the children. Sociometry is a qualitative method for measuring social relationships. It was originally developed by psychotherapist Jacob L. Moreno in his studies of the relationship between social structures and psychological well-being. Sociometry is based on the fact that people make choices in interpersonal relationships.

Raven's Progressive Matrices and Reynolds Intellectual Assessment Scale were used for cognitive assessments. Raven's Progressive Matrices are multiple choice tests of abstract reasoning (Raven, J. C, 1936). In each test item, a candidate is asked to identify the missing segment required to complete a larger pattern. Raven's Progressive Matrices and Vocabulary tests measure the two main components of general intelligence (originally identified by Charles Spearman): the ability to think clearly and make sense of complexity in a child (Raven, J., Raven,

J.C., & Court, J.H. 2003). The Reynolds Intellectual Assessment Scale (RIAS) is a comprehensive, cost-effective, high-quality intelligence test (Reynolds, C. R., and Kamphaus, R. W. 2003). The RIAS intelligence subtests include Verbal Reasoning (verbal), Guess What (verbal), Odd-Item Out (nonverbal), and What's Missing (nonverbal). Memory subtests include Verbal Memory and Nonverbal Memory (Reynolds and Kamphaus, 2003). It provides a thorough assessment of the client's level of intellectual functioning and allows the assessor to evaluate the relationship between the client's memory and cognitive skills.

A pilot study was conducted on a small sample to pretest the questionnaire for clarity and specificity. Then the main survey was conducted. The collected data was classified, tabulated and analyzed in order to facilitate comparison and the hypotheses were tested for significance (Kothari C., 2004)

RESULTS AND DISCUSSION

The present study was designed to identify consanguineous partners and their children with particular reference to their health status and compare the same with children of non – consanguineous partners. The results are discussed below.

Post-natal health status of children of selected partners (consanguineous and non-consanguineous)

Table 1 depicts the post natal health status of children of selected partners comprising of birth weights, respiratory rate, heart rate, sensory system and body movements.

Table 1: Post-natal health status of children of selected partners

S.No.	Details	Consanguineous marriage N= 75						Non-Consanguineous marriage N= 75					
		Normal		Below Normal		Above Normal		Normal		Below Normal		Above Normal	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Birth weights	16	21.3	59	78.7	-	-	55	73.3	20	26.7	-	-
2	Respiratory rate	19	25.3	56	74.7	-	-	52	69.3	23	30.7	-	-
3	Heart rate	27	36.0	48	64.0	-	-	64	85.3	11	14.7	-	-
4	Sensory system	24	32.0	51	68.0	-	-	60	80.0	15	20.0	-	-
5	Body movements (shaking hands & legs)	31	41.3	44	58.7	-	-	67	89.3	8	10.7	-	-

*Total exceeds 100 due to multiple responses

From Table 1 and Figure 1 it can be observed that 78.7 percent of consanguineous and 26.7 percent of non-consanguineous partners had children below normal birth weight whereas 21.3 percent of consanguineous and 73.3 percent of non-consanguineous partners had children of normal birth weight. 25.3 percent of consanguineous and 69.3 percent of non-consanguineous partners had children with normal respiratory rate whereas below normal respiratory rate was observed in children 74.7 percent of consanguineous and 30.7 percent of non-consanguineous marriages. Majority (consanguineous 36 percent and non-consanguineous 85.3 percent) of the children of selected partners had normal heart rate. Sensory system functioned normally in majority (80 percent) of the children of non-consanguineous partners and 32 percent of the children of consanguineous partners. Majority of the children of selected consanguineous partners (58.7 %) had below normal motor development. Normal motor development was observed in (41.3 percent) of consanguineous and (89.3 percent) of non-consanguineous children. It can be summarized that the post-natal health status of children was better in non-consanguineous marriage as compared to consanguineous marriage with regard to body weight, respiratory rate, heart rate, sensory system and body movements.

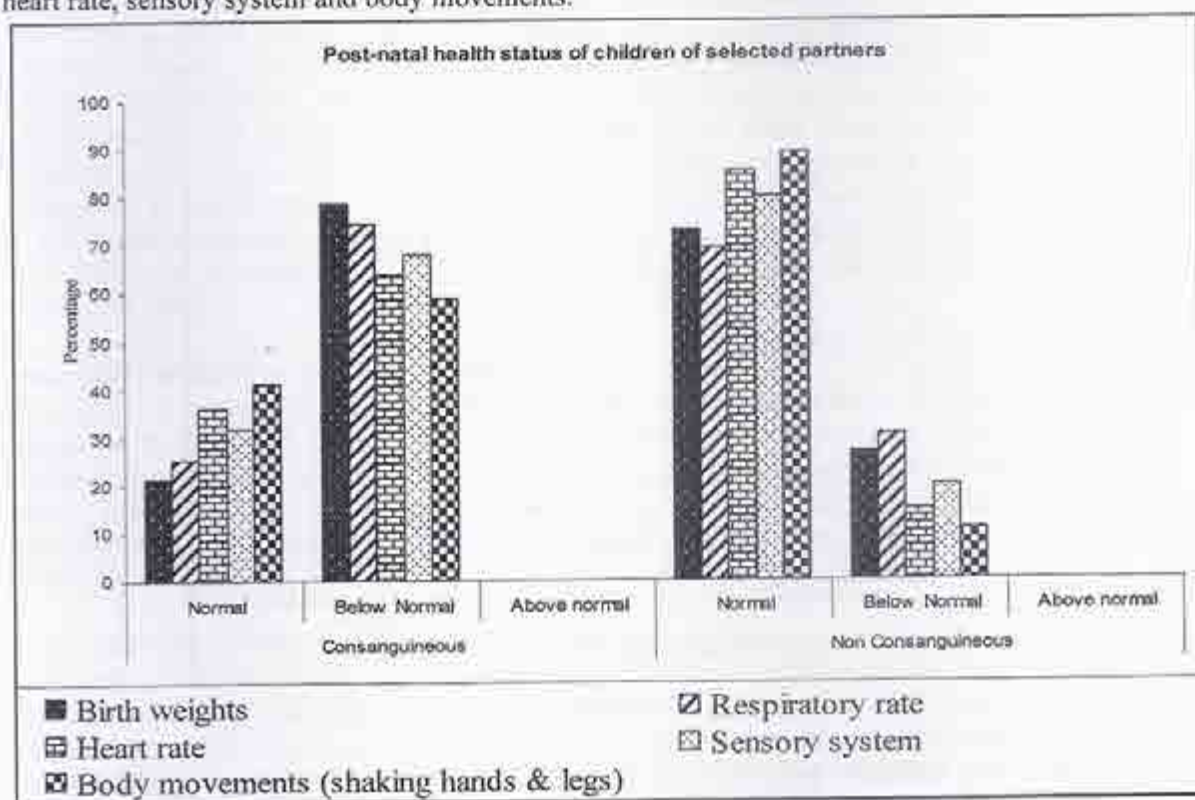


Figure 1

Comparison of the health problems of children of selected partners

Table 2 and figure 2 shows the comparison of health problems of the children of selected partners. The scores represent the mean number of specified health problems present.

Table 2: Comparison of health problems of children of consanguineous and non-consanguineous partners

	Marriage	N	Mean	Std. deviation	Std. Error mean	't' value
Children health problems	Consanguineous marriage	75	2.39	2.609	0.301	3.734**
	Non-Consanguineous marriage	75	1.03	1.755	0.203	

**Significant at one percent level

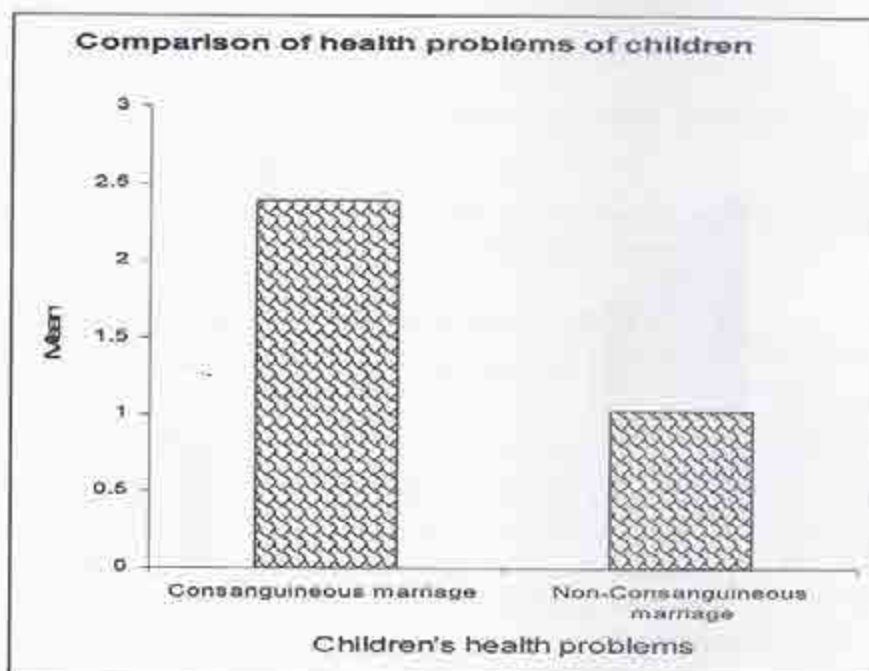


Figure 2

The findings of the study showed significant difference in the health problems of children of selected partners (consanguineous 2.39 + 2.609 and non-consanguineous 1.03 + 1.755) at one percent level of significance. This table and Figure 2 explicitly brings to light the significant difference in the health status of children from consanguineous and non-consanguineous marriages. These findings correlate with the findings of Bener, A (2006) which showed that the problems faced by the children from consanguineous marriage was slightly higher than the problems faced by children from non-consanguineous marriage such as cancer, eye disorders, anaemia and physical disability.

Cognitive development of the children of selected partners

Table 3 showed the mean difference between cognitive development scores of children of selected partners.

Table 3: Mean difference between cognitive development scores of children of selected consanguineous and non-consanguineous partners

	Marriage	N	Mean	Std. deviation	Std. Error mean	't' value
Cognitive test	Consanguineous marriage	75	36.04	11.994	1.385	2.165*
	Non-consanguineous marriage	75	39.76	8.812	1.017	

* Significant at Five percent level

Statistical analysis by student's t' test showed that there was significant difference in the cognitive development of the children of selected partners (consanguineous 36.04 + 11.994 and non-consanguineous 39.76 + 8.812) at five percent level. This was assessed by means of Raven's progressive matrix, Reynolds Intellectual Assessment Scale and also by means of reasoning and objective type questions. These findings correlate with research conducted by (Woodley, 2009) which clearly state that consanguineous marriage has a direct influence on the cognitive development of children. In unrelated mating the probability of producing a child with a serious birth defect or mental retardation is 3 - 4 %. This figure doubles in first cousin mating and triples in uncle - niece and aunt - nephew marriage. A recent review reported an increase in incidence of birth defects for first cousin progeny of 0.7 to 7.5% as compared to non-consanguineous couples (Zlotogora, 2002).

Sociometry of children of selected partners

Sociometry is a qualitative method for measuring social relationships. The sociometry was conducted by means of a questionnaire and the sociological development of the children was traced. The sociometry of the children of selected partners comprised mingling of children with others, expression of children, characteristics of children, child dresses to their own choice, communication of children with parents and teachers (Bittles A.H. (2008). These details are presented in Table 4.

It was interesting to note that the children of non-consanguineous marriage were more social as compared to children of consanguineous marriage (Benner, E 2006) Majority of the children of non-consanguineous marriage mingled with others (94.7 percent), developed good communication (92.0 percent), played games with others and developed hobbies with other children (90.7 percent each). The child was interested to playing with the peer group (89.3 percent) and liked to dress according to their choice (88 percent) and enjoyed sitting with other children and talking (86.3 percent). These qualities were lacking in children of consanguineous marriage and a predominance of individual play (solitary play) was seen in (68 percent) of them, it was also observed that extrovert qualities were present in children of non consanguineous parents (Berk LE (2004).

Table 4: Sociometry of the children of selected partners

Sl.No	Sociological Aspects	Consanguineous marriage		Non-Consanguineous marriage	
		N=75	%	N=75	%
1	Child mingles with other children	28	37.3	71	94.7
2	Ways of expression of children				
	i) Playing games with others	18	24.0	68	90.7
	ii) Sitting with other children & talking	15	20.0	65	86.3
	iii) Developing hobbies with other children	8	10.7	68	90.7
	iv) Share things with others (foods etc.,)	12	16.0	56	74.7
3	Characteristics of child				
	i) Playing individually	51	68.0	8	10.7
	ii) Playing with peer groups	24	32.0	67	89.3
4	Child dresses according to their choice	20	26.7	66	88.0
5	Child communicate with parents and teachers				
	i) By words	37	49.3	69	92.0
	ii) By Action	36	48.0	5	6.7
	iii) By Expression	2	2.7	1	1.3

* Total exceeds 100 due to multiple responses

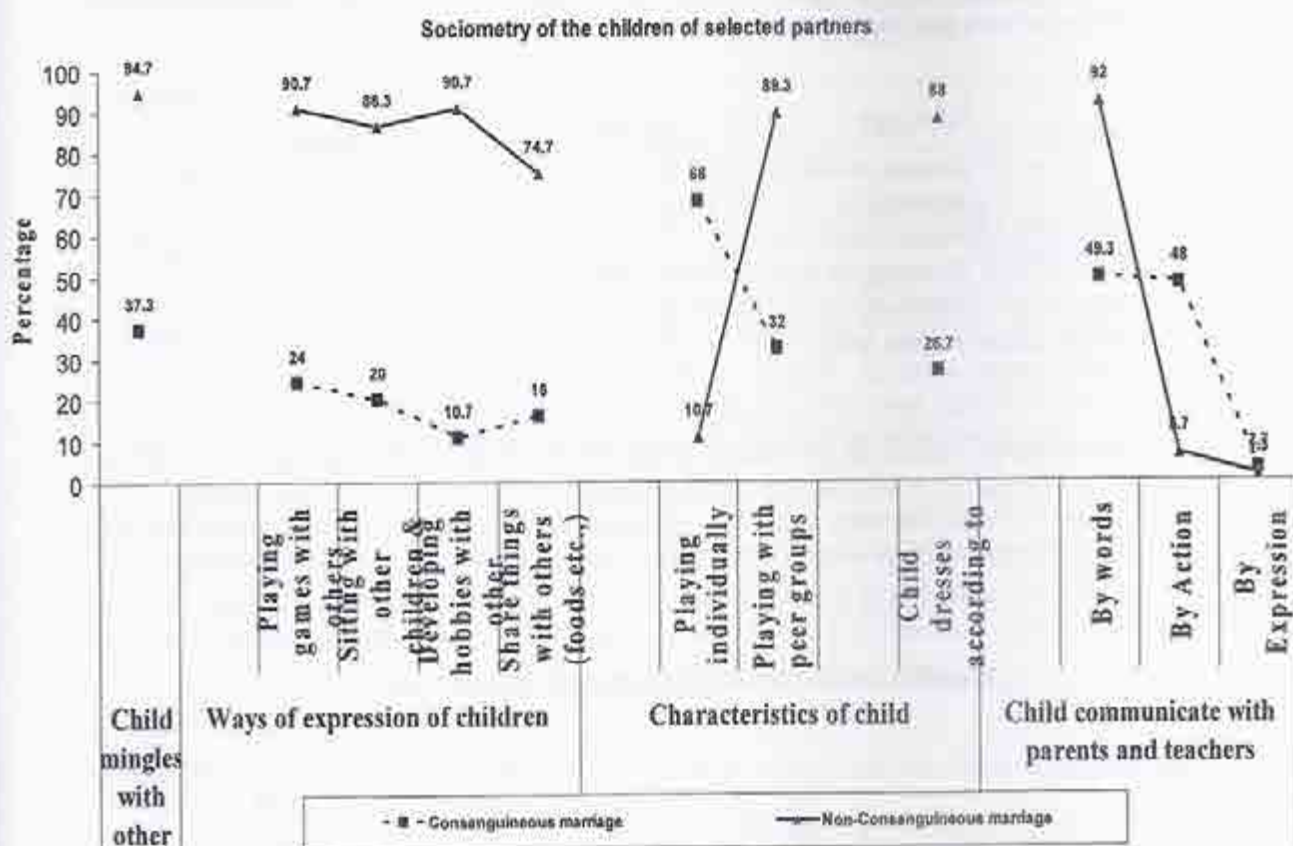


Figure 3

Comparison of the health problems of pregnant mothers of selected partners

The health problems of pregnant mothers of selected partners from consanguineous and non-consanguineous marriage are given below in table 5. Information regarding the health problems experienced by the selected mothers during pregnancy like anaemia, oedema, increased heart beat, poor appetite, abnormal blood pressure, diabetes was gathered using an interview schedule. The scores represent the mean number of specified health problems present.

Table 5: Comparison of the health problems of pregnant mothers between consanguineous and non-consanguineous partners

	Marriage	N	Mean	Std. deviation	Std. Error mean	't' value
Health problems of pregnant mothers	Consanguineous marriage	75	3.13	2.32	0.27	2.77**
	Non-Consanguineous marriage	75	2.21	1.69	0.19	

** Significant at one percent level

The obtained mean values of the health problems of pregnant mothers of consanguineous marriage was high (3.13 + 2.32) as compared to mothers of non-consanguineous marriage (2.21 + 1.69), such as repeated abortions, infertility, depression and symptoms of melancholy, indicating a significant difference at one percent level. From Table 5 and Figure 4 the findings of the study



Figure 4

revealed that pregnant women belonging to consanguineous marriage have greater health problems as compared to their counterparts from non-consanguineous marriage. Through a population-based health survey the effect of consanguineous marriages were investigated in

Beirut. Total pregnancies, live births, and living children were significantly higher among consanguineous couples than among nonconsanguineous ones (M Khat, 1988)

CONCLUSION

Several scientific studies have shown that consanguinity increases the risk of infant death before, during or immediately after birth, increased incidence of birth defects, genetic diseases including blinding disorders, blood cancer, breathing problems for children at birth (apnea) and increased susceptibility to diseases. Consanguinity could increase the risk of inheriting any one of the 4968 (autosomal recessive) genetic diseases that could affect any part of the body from head to foot (The Hindu, 2004). Thus it can be concluded from the above study that the health status of children [physical, mental and emotional] and the health of the mothers are affected in consanguineous marriages between first cousins. There appears to be a direct relationship between the degree of consanguinity and physical, mental and emotional health of the children and mother. However, this needs to be evaluated further in the light of other confounding factors.

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