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ABOUT THE JOURNAL:

RESEARCH REACH – Journal of Home Science, is a peer-reviewed journal registered by the National Institute of Science Communication and Information Resources (**ISSN 0974 – 917X**) and recognized amongst UGC list of publications. It is a bi-annual publication from the Research Centre, College of Home Science, Nirmala Niketan (NAAC Accreditation: "A" Grade).

The journal invites previously unpublished original articles and review articles from students, faculty, and researchers in the fields of Nutrition and Dietetics, Human Development, Home Science Extension Education, and Textile Sciences.

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From the Editor's Desk

It gives me immense pleasure and pride to welcome the new team of the Research Centre, our esteemed members of the advisory board, and our expert reviewers for being part of our journal Research Reach.

I apologize for the delay caused in bringing out the July 2017 issue, please bear with us. This journal has been serving as a forum for scientists, including young scholars to publish and share their research achievements. The journal covers original and authentic research and development work from all the branches of Home Science. It is widely subscribed to, by individuals and educational institutions across India. Sixteen volumes of the journal have been brought out so far since 2002. The most interesting achievement is that the journal is listed in the UGC list of approved journals.

The July 2017 issue of "Research Reach" brings to the readers an interesting blend of research articles in the field of community nutrition and innovations in food technology contributed by researchers from the Department of Food Science & Nutrition. We have continued our efforts to include quality research articles from all domains of Home Science and its related fields and would greatly appreciate your contributions towards the same. Wish you all a rewarding sharing and learning research experience.

UPCOMING EVENT

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Dr. Geeta Ibrahim
Chief Editor

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STANDARDIZATION OF BARNYARD MILLET VERMICELLI INCORPORATED WITH FENUGREEK AND GARDEN CRESS SEED

S. Chandraprabha[1] and Dr. Sharon C. L.[2]

Millets are small-seeded cereals which are a good source of B vitamins and minerals like calcium, iron, potassium, magnesium and zinc. Millets can substitute major cereals for better health benefits. Barnyard millet (*Echinochloa frumentacea*) is a nutritious grain, coupled with slowly digestible carbohydrate and highly digestible protein which can be used to prepare various value-added products. Functional ingredients such as fenugreek and garden cress seed may be incorporated into various food products to improve its sensory, nutritional and health quality. These ingredients are rich in nutrients and help to prevent type II diabetes, heart disease, reduce total cholesterol, LDL levels, and blood pressure. The present study aims to develop barnyard millet vermicelli incorporated with fenugreek seed and garden cress seed. The formulated barnyard millet vermicelli and *uppuma* prepared out of it were evaluated for sensory acceptability. Based on the results of organoleptic evaluation vermicelli prepared with 40% germinated barnyard millet flour, 58% whole wheat flour and 2% germinated fenugreek seed/garden cress seed flour had a high mean score. The overall acceptability of barnyard vermicelli incorporated with germinated fenugreek and garden cress seed had obtained a mean score of 9.07 and 9.34. *Uppuma* made with prepared vermicelli had a mean score 9.44 and 10.07 respectively. Hence germinated barnyard millet vermicelli and *uppuma* prepared by incorporation of functional ingredients (fenugreek and garden cress seed) had a better acceptability and may have a good nutritional profile.

Keywords: Barnyard Millet, Fenugreek Seed, Garden Cress Seed, Vermicelli, Organoleptic Evaluation

INTRODUCTION

Extruded products are being popular in today's world due to the changing lifestyle, urbanization, family structure, and value system. Among the extruded products, vermicelli has been a traditional food product prepared in India with refined wheat flour (Mogra and Midha, 2013). Nowadays people with nutritious knowledge are more interested in foods fortified with functional ingredients. Functional foods are made from ingredients which provide a beneficial effect to the body other than nutrition (International Food Information Council, 2006). Millets are accepted as functional food because they provide B vitamins, calcium, iron, potassium, magnesium, zinc, dietary fibre, photochemical and antioxidants required for human health (Truswell, 2002). Millets act as therapeutic food, which helps to control blood pressure, diabetes, heart disease and atherosclerosis (Prabha and Selvi, 2016). Barnyard millet (*Echinochloa frumentacea*) is minor millet commonly known as Japanese barnyard millet, *Ooda, Oadalu, Sawan,* and *Sanwank.*

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Barnyard millet is one of the underutilized millets, but it is considered to be one of the nutritious grains than other cereals due to the fair amounts of protein (12%) that is highly digestible (81.13%) coupled with low carbohydrate content (58.56%) of slow digestibility (25.88%) (Veena and Chimmad, 2003). Currently, consumers are focusing on the value-added products with several ingredients to improve their nutritional status which significantly increases the market demand. Fenugreek (*Trigonella foenum-graecum*) seeds used in traditional food preparation have several functional properties. Fenugreek seed contains protein (25–30%), galactomannans (20–30%), insoluble fibre (20–25%), lipids (7–9%), saponins (5–7%) and ash (3–4%). Fenugreek seed act as antidiabetic, anticarcinogenic, antioxidant, antibacterial, prevents hypercholesterolemia and hypoglycemia (Meghwal and Goswami, 2012). Garden cress seed (*Lepidium sativum L.*) are rich in iron (100 mg/100g) and also contains several nutraceutical components. The seeds possess fair levels of protein (22.50%), fat (27.50%), dietary fibre (30.00%) and calcium (0.377 %) (Sood and Sharada, 2002). It can be specially given to girls at menarche and after delivery. Garden cress seeds can be added to millet flour to develop nutrient enriched millet flakes (Kotagi *et al.,* 2013). Millet flour along with fenugreek seed and garden cress seed powder may have a good functional property and can be used in various food products.

The present study was conducted to prepare barnyard millet based designer vermicelli with a combination of germinated barnyard millet flour incorporated with fenugreek seed and garden cress seed powder which may have good acceptability and a better nutritional profile.

MATERIALS AND METHODS

Procurement of raw material

Barnyard millet was collected from the farmers of Pollachi in Tamil Nadu. The obtained barnyard millet was cleaned, soaked in water for 10 hours and undergone a process of germination for 24 hours. The germinated barnyard millet was de-vegetated, powdered and sieved to obtain uniform flour. Wheat flour and refined wheat flour (which served as a control), fenugreek seeds and garden cress seeds were purchased from the local market in Thrissur, Kerala. Fenugreek seeds were germinated as per the procedure suggested by Pandey and Awasthi (2014). The fenugreek seed was cleaned and soaked in water for 12 hours with an intermittent change of water for 6 hours, which was followed by germination for 24 hours. The seed was de-vegetated, powdered and sieved through 40 mesh size to obtain a uniform powder. Garden cress seeds were dried, powdered and sieved through a 40 mesh size to get a uniform fine powder.

Preparation of vermicelli

Vermicelli was prepared with a combination of germinated barnyard millet, whole wheat flour with fenugreek seed flour (Table 1) and garden cress seed flour (Table 2). The ingredients were mixed by adding 25-30% of water to form the dough.

The prepared dough was extruded to the desired length in a tray. The extruded vermicelli was dried in a hot air oven at 55˚-65˚C for 4 to 5 hours. The dried vermicelli was packed in polyethylene pouches (Ranganna *et al*., 2014).

Table 1: Treatments for fenugreek incorporated barnyard vermicelli

Treatments	Combinations
T_0	Control (100% Refined wheat flour)
T_1	80% BMF + 15% WWF + 5% F
T_2	80% BMF + 18% WWF+ 2% F
T_3	70% BMF+ 25% WWF + 5% F
T_4	70% BMF+ 28% WWF + 2% F
T_5	60% BMF+ 35% WWF + 5% F
T_6	60% BMF+ 38% WWF + 2% F
T_7	50% BMF + 45% WWF + 5% F
T_8	50% BMF+ 48% WWF + 2% F
T_9	40% BMF + 55% WWF + 5% F
T_{10}	40% BMF + 58% WWF + 2% F

(*BMF – Germinated barnyard millet flour, WWF – Whole wheat flour, F - Germinated fenugreek seeds powder)

Table 2: Treatments for garden cress seed incorporated barnyard vermicelli

Treatments	Combinations
T_0	Control (100% Refined wheat flour)
T_1	80% BMF + 15% WWF + 5% G
T_2	80% BMF + 18% WWF+ 2% G
T_3	70% BMF + 25% WWF + 5% G
T_4	70% BMF + 28% WWF + 2% G
T_5	60% BMF + 35% WWF + 5% G
T_6	60% BMF + 38% WWF + 2% G
T_7	50% BMF + 45% WWF + 5% G
T_8	50% BMF+ 48% WWF + 2% G
T_9	40% BMF + 55% WWF + 5% G
T_{10}	40% BMF+ 58% WWF + 2% G

(*BMF – Germinated barnyard millet flour, WWF – Whole wheat flour, G - Garden cress seed powder)

Preparation of *uppuma*

From the vermicelli of all the combinations, *uppuma* was prepared. For the preparation of *uppuma* 25gm of the vermicelli was roasted, cooked with 90ml of the water and 5g of the other ingredients (mustard, onion, green chilli and curry leaves).

Organoleptic evaluation

The sensory evaluation was carried out for the prepared raw vermicelli and *uppuma* with a panel of 15 judges considering the six sensory attributes (appearance, colour, flavour, texture, taste and overall acceptability) using a nine-point hedonic scale.

Statistical analysis

The mean values for the obtained data for the various sensory attributes were accessed. The best treatment in both combinations was identified from the interpretation of Kendall's Coefficient of Concordance (W).

RESULTS AND DISCUSSION

Organoleptic evaluation

Barnyard millet based vermicelli incorporated with the functional ingredients were subjected to sensory evaluation by a panel of 15 judges and the results are presented in Table 3 and 5. *Uppuma* prepared from barnyard millet based designer vermicelli was undergone organoleptic evaluation and results are detailed in Table 4 and 6.

Table 3 and 4 depicts that all the treatments were significant at 1%. The sensory parameters (appearance, colour, flavour, texture, taste, and overall acceptability) of fenugreek incorporated barnyard millet vermicelli and *uppuma* ranked highest mean score in treatment T_{10} (40% germinated barnyard millet flour with 58% wheat flour and 2% germinated fenugreek seed flour). Shirani and Ganesharanee (2008) revealed that fenugreek flour incorporated at more than 2% in chickpea based extruded snack was unacceptable. Bread prepared with fenugreek seed flour significantly reduced insulin resistance and type II diabetes (Losso *et al.,* 2009). The observed results were similar to that Wani and Kumar (2015), in which extruded snack products incorporated with 2 % of fenugreek seed flour was most acceptable. The main factor to reduce the incorporation rate to 2% is due to its bitter taste. They concluded that to improve the sensory and nutritional properties of vermicelli fenugreek can be germinated/ roasted. The consumption of germinated fenugreek seed powder lowers the cholesterol and LDL levels (Sowmya and Rajyalakshmi, 1999).

Table 3: Mean score for organoleptic evaluation of fenugreek incorporated barnyard vermicelli

Treatments	Sensory Attributes					
	Appearance	**Colour**	**Flavour**	**Texture**	**Taste**	**Overall acceptability**
T_0	8.80 (10.77)	8.66 (11.00)	8.60 (10.83)	8.55 (10.73)	8.95 (10.80)	8.55 (11.00)
T_1	6.37 (3.60)	6.44 (3.00)	5.57 (2.37)	5.84 (3.57)	6.42 (3.80)	5.86 (2.93)
T_2	6.31 (3.27)	6.35 (2.60)	5.77 (2.93)	5.84 (3.43)	6.37 (3.37)	5.75 (2.43)
Treatments	**Sensory Attributes**					
	Appearance	**Colour**	**Flavour**	**Texture**	**Taste**	**Overall acceptability**
T_3	6.75 (2.97)	6.44 (2.83)	5.95 (3.40)	5.80 (3.10)	6.82 (4.07)	5.93 (2.90)
T_4	6.28 (2.33)	6.48 (2.90)	5.77 (3.33)	5.84 (3.13)	6.31 (2.20)	5.95 (2.93)
T_5	7.02 (4.60)	6.91 (4.83)	6.20 (4.23)	6.22 (4.40)	7.02 (4.57)	6.53 (4.97)
T_6	7.24 (5.63)	7.13 (5.97)	6.44 (5.40)	6.15 (4.37)	7.22 (5.47)	6.82 (6.20)
T_7	7.44 (6.73)	7.44 (7.57)	7.11 (6.83)	6.62 (6.33)	7.44 (6.67)	7.22 (7.37)
T_8	7.77 (7.57)	7.42 (7.43)	7.48 (7.77)	7.35 (7.97)	7.77 (7.50)	7.37 (7.67)
T_9	8.04 (8.37)	7.68 (8.87)	8.02 (9.03)	7.84 (9.43)	8.08 (8.43)	7.62 (8.53)
T_{10}	8.44 (9.17)	7.77 (9.00)	8.20 (9.87)	8.00 (9.53)	8.40 (9.13)	7.77 (9.07)
Kendall's W	.729**	.866**	.822**	.855**	.781**	.866**

Value in parentheses is mean rank score based on Kendall's W

** Significant at 1% level

Table 4: Mean score for organoleptic evaluation of fenugreek incorporated barnyard *uppuma*

Treatments	Sensory Attributes					
	Appearance	**Colour**	**Flavour**	**Texture**	**Taste**	**Overall acceptability**
T_0	8.86 (10.97)	8.75 (10.87)	8.55 (10.43)	9.17 (10.59)	8.26 (10.96)	8.75 (10.81)
T_1	6.57 (4.20)	6.37 (3.30)	6.11 (2.67)	5.93 (2.28)	6.24 (4.18)	6.37 (3.34)
T_2	6.20 (2.90)	6.20 (2.73)	6.06 (2.57)	6.17 (2.84)	5.97 (3.04)	6.20 (2.62)
T_3	6.31 (3.97)	6.37 (3.30)	6.51 (4.03)	6.28 (3.50)	5.97 (3.93)	6.37 (3.38)
T_4	6.20 (2.77)	6.37 (3.13)	6.37 (3.63)	6.14 (3.28)	5.91 (2.82)	6.37 (3.06)
T_5	6.57 (3.80)	6.55 (4.20)	6.57 (3.80)	6.62 (4.06)	6.76 (3.86)	6.55 (4.12)
T_6	6.84 (4.60)	6.93 (5.63)	6.82 (4.73)	7.06 (5.47)	6.44 (4.50)	6.93 (5.66)
Treatments	**Sensory Attributes**					
	Appearance	**Colour**	**Flavour**	**Texture**	**Taste**	**Overall acceptability**
T_7	7.40 (6.53)	7.15 (6.40)	7.44 (7.20)	7.48 (6.97)	6.95 (6.50)	7.15 (6.47)
T_8	7.77 (8.27)	7.51 (7.97)	7.75 (8.33)	7.95 (8.12)	7.31 (8.29)	7.51 (7.99)
T_9	7.91 (8.70)	7.77 (9.20)	7.88 (8.80)	8.40 (9.41)	7.42 (8.64)	7.77 (9.22)
T_{10}	8.04 (9.30)	7.80 (9.30)	8.22 (9.80)	8.46 (9.47)	7.55 (9.29)	7.88 (9.34)
Kendall's W	.791**	.866**	.822**	.855**	.781**	.866**

Value in parentheses is mean rank score based on Kendall's W

**Significant at 1% level

Data from the Table 5 and 6, it clearly showed that vermicelli and *uppuma* prepared with treatment T_{10} (40% barnyard millet flour, 58% wheat flour and 2% of garden cress seed) were highly acceptable in all the sensory attributes. The statistical interpretation shows that Kendall's W was significant at 1% among all the treatments. Ballolli and Chimmad (2010) proved that incorporation of garden cress seed to barnyard millet was found to be highly acceptable with excellent textural qualities. Vijayanchali and Devi (2013) formulated iron-rich antioxidant mix with the addition of 2% garden cress seed which can be used to prepare porridge and nutriballs of good acceptability.

The value-added biscuits prepared with de-oiled coconut meal flour and rice flour by incorporating 2.5gm garden cress seeds was found to be high in iron content (Sivakami and Sarojini, 2013).

Table 5: Mean score for organoleptic evaluation of garden cress seed incorporated barnyard vermicelli

Treatments	Sensory Attributes					
	Appearance	**Colour**	**Flavour**	**Texture**	**Taste**	**Overall acceptability**
T_0	8.68 (10.67)	8.73 (10.87)	8.55 (10.80)	8.68 (10.93)	8.55 (11.00)	8.66 (10.97)
T_1	5.77 (2.17)	6.13 (2.47)	6.46 (3.33)	5.60 (2.13)	5.75 (2.37)	5.71 (2.61)
T_2	5.68 (2.00)	6.06 (2.63)	6.42 (2.80)	7.33 (3.23)	5.86 (2.97)	5.80 (2.72)
T_3	6.08 (3.07)	6.62 (4.27)	6.48 (3.20)	5.86 (3.03)	5.91 (2.90)	5.84 (3.00)
T_4	6.22 (3.44)	6.64 (4.20)	6.55 (3.30)	5.53 (2.27)	6.06 (3.47)	6.13 (3.97)
Treatments	**Sensory Attributes**					
	Appearance	**Colour**	**Flavour**	**Texture**	**Taste**	**Overall acceptability**
T_5	6.78 (5.07)	6.84 (4.87)	6.93 (5.37)	6.53 (5.67)	6.60 (5.60)	6.64 (5.62)
T_6	7.04 (5.77)	7.24 (5.67)	7.28 (7.20)	6.71 (5.73)	6.68 (5.67)	7.71 (5.75)
T_7	7.35 (6.83)	7.37 (6.53)	7.35 (7.53)	7.40 (7.50)	7.15 (7.20)	7.06 (6.59)
T_8	7.64 (7.70)	7.51 (7.10)	7.24 (6.20)	7.48 (7.83)	7.33 (7.93)	7.37 (7.69)
T_9	8.00 (9.20)	7.80 (8.73)	7.53 (7.90)	7.66 (8.47)	7.33 (7.57)	7.53 (8.09)
T_{10}	8.06 (9.53)	7.80 (8.77)	7.60 (8.37)	7.78 (8.60)	7.68 (9.33)	7.88 (9.44)
Kendall's W	.885**	.703**	.667**	.808**	.795**	.779**

Value in parentheses is mean rank score based on Kendall's W

** Significant at 1% level

Table 6: Mean score for organoleptic evaluation of garden cress seed incorporated barnyard *uppuma*

Treatments	Sensory Attributes					
	Appearance	**Colour**	**Flavour**	**Texture**	**Taste**	**Overall acceptability**
T_0	8.82 (10.67)	8.75 (10.60)	8.55 (10.40)	8.62 (10.83)	8.73 (10.70)	8.73 (10.60)
T_1	5.77 (2.43)	5.91 (2.77)	6.37 (2.53)	5.62 (2.03)	5.48 (2.17)	5.77 (2.33)
T_2	5.71 (1.77)	5.71 (1.87)	6.42 (2.63)	5.62 (2.00)	5.44 (1.73)	5.75 (2.17)
T_3	6.08 (2.77)	6.20 (2.70)	6.48 (2.97)	6.06 (3.43)	6.00 (3.60)	6.20 (3.50)
T_4	6.37 (3.73)	6.55 (3.90)	6.48 (3.23)	6.13 (3.70)	6.00 (3.97)	6.04 (3.13)
T_5	7.00 (5.33)	7.02 (5.50)	7.00 (5.23)	6.62 (5.13)	6.71 (5.77)	6.86 (5.30)
T_6	7.20 (6.50)	7.24 (6.47)	7.13 (6.25)	6.77 (5.77)	6.66 (5.27)	6.91 (5.59)
T_7	7.48 (6.57)	7.51 (6.83)	7.44 (7.27)	7.33 (7.40)	7.20 (6.50)	7.33 (7.03)
Treatments	**Sensory Attributes**					
	Appearance	**Colour**	**Flavour**	**Texture**	**Taste**	**Overall acceptability**
T_8	7.73 (7.77)	7.68 (7.51)	7.51 (7.20)	7.42 (7.53)	7.64 (8.20)	7.44 (7.50)
T_9	8.17 (8.93)	8.11 (9.00)	7.91 (9.13)	7.77 (8.83)	7.88 (8.93)	7.84 (8.80)
T_{10}	8.40 (9.53)	8.24 (9.40)	8.04 (9.17)	7.91 (9.33)	8.06 (9.17)	8.31 (10.07)
Kendall's W	.875**	.870**	.790**	.858**	.833**	.857**

Value in parentheses is mean rank score based on Kendall's W

** Significant at 1% level

On comparison of barnyard vermicelli and *uppuma* prepared with fenugreek and garden cress seed with control (refined wheat flour), the overall acceptability was found to be high in control but refined wheat flour is low in nutrient content and dietary fibre and its regular consumption associated with several health complications like diabetes, heart disease, and blood pressure. Products made from cereal grains are rich in nutrients and dietary fibre and which improved its physical, sensory and nutritional properties (Kumari and Sangeetha, 2013).

CONCLUSION

The study revealed that barnyard millet vermicelli incorporated with a combination of 40% germinated barnyard millet flour and 2% of functional ingredients (fenugreek and garden cress seed) found to be well accepted for all its organoleptic properties. Barnyard millet based product development and market promotion may help the consumers to add variety to their diet and reduce several health complications.

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CONFLICT OF INTEREST

Nil

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QUALITY EVALUATION OF "GRAND NAINE CV. *MUSA* (AAA GROUP)" BANANA CHIPS

Sruthy P. M.[1] and Dr. Seeja Thomachan Panjikkaran[2]

Grand Naine banana is a popular high yielding cultivar and is one among the most popular banana varieties commonly grown in India. During peak season, due to a large volume of fruits available and due to the perishable nature of the commodity, the producers are faced with low returns. Fully grown unripe Grand Naine was used for the preparation of chips and it was divided into two lots. One lot was salted (T_1) and other was salted and spiced (T_2).The organoleptic qualities of freshly prepared chips were assessed using nine-point hedonic scale (Jellinek, 1985). Physical qualities like frying time, oil content, moisture content, weight gain, and product recovery were assessed using standard procedures (Ranganna, 1991).Both the treatments T_1 and T_2 were found to be acceptable with scores more than 7.5 in all organoleptic attributes. Kendall's value revealed a significant agreement among judges. The frying time and moisture content were less for grand naine chips (4 minutes and 6 seconds, 5% respectively) compared to ordinary nendran chips (5 minutes, 5.66% respectively). The oil content was 38% and product recovery was 40% for grand naine chips with a production cost of Rs 188/ kg. This value-added product will help to prevent the post-harvest loss and fetch an additional income.

Keywords: Grand Naine Banana, Grand Naine Chips, Frying Time, Oil Content, Moisture Content, Product Recovery, Production Cost

INTRODUCTION

Banana *(Musa paradisiaca L*) is a herbaceous plant belonging to the family *Musaceae* and it is also known as "Apple of paradise." It is one of the most important fruit crops in India. India leads the world in the production of banana with an annual production of 264.7 lakhs tones out of total world production of 950 lakh tones (NHB, 2010).It has nutritional, medicinal, industrial as well as aesthetic value in Hindu religion. The net post-harvest losses of banana are estimated between 20 and 40 % and were due to improper handling, transport, marketing and processing (Sethi and Anand, 1987). Grand Naine is a popular high yielding cultivar and is one among the most popular banana varieties commonly grown in India. Major constraints associated with the post-harvest handling of fresh Grand Naine banana are heavy bunches and short shelf life. The post-harvest loss can be minimized through processing of the product. Usha and Srivastava (1995) had reviewed the trends and opportunities in fruits and vegetable processing in India and observed that the country processed 1.1 % of fruits. The annual loss of fruits and vegetables in India accounted for Rs3000 to 4000 crores in monetary terms in the last five years. This necessitates for an evolution of more product formulations, as the export of these would be more profitable than the export of fresh produce.

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Processing of fruit and vegetables and development of shelf-stable value-added products would definitely help in reducing the post-harvest losses.

Chips are one among the most popular snack item in Kerala. In the present study, Grand Naine banana was used for preparing chips. Process optimization and quality aspects of chips from Grand Naine banana is an area which has not been explored yet.

MATERIALS AND METHODS

Collection of raw ingredients

The fully grown unripe Grand Naine banana was collected from the Banana Research Station (BRS), Kannara of Kerala Agricultural University. All other ingredients required for the study were purchased from the local market.

Preparation of Grand Naine chips

The fully grown unripe banana was washed in clean water. It was peeled manually and the fruits were cut into a uniform size of 2mm thickness. After slicing they were divided into two lots and were fried in coconut oil. One lot was salted and other was salted and spiced.

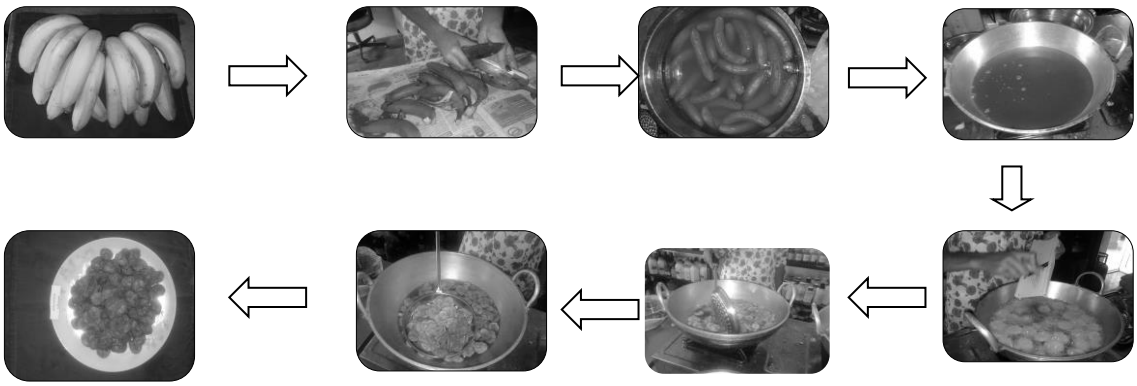

Figure 1 - Preparation of "Grand Naine" banana chips

Organoleptic Evaluation

Organoleptic evaluation of Grand Naine banana chips was conducted by using score card by a panel of 15 judges.

Selection of judges

A panel of 15 judges was selected by standard procedure (Jellinek, 1985). The fresh chips were evaluated by the selected judges using a score card with nine-point hedonic scale. Parameters like appearance, colour, flavour, texture, taste, crispiness and overall acceptability were evaluated.

Physical Analysis

The physical quality parameters like frying time, oil content, moisture content, weight gain and product recovery of freshly prepared Grand Naine chips were done using the standard procedure suggested by Ranganna (1991).

1. Frying time

Fresh Grand Naine banana slices were dried up to 5 % moisture level using hot air oven at 50˚c for one hour. It was then fried in coconut oil and the time required for frying was determined.

2. Oil content

The percentage of oil content was calculated as follows:

$$\% \text{ oil content} = \frac{\text{Weight of oil}}{\text{Weight of sample}} \times 100$$

3. Moisture content

The moisture content of chips was estimated by the method of A.O.A.C (1980). To determine the moisture content of the products, five gram of sample was taken in a Petri dish and dried at 60^0c to 70^0c in a hot air oven, cooled in a desiccator and weighed. The process of heating and cooling was repeated till constant weight was achieved. The moisture content of the sample was calculated from the loss in weight during drying.

$$\text{Moisture content (\%)} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

4. Weight gain

The percentage of weight gain was calculated as follows:

$$\% \text{ weight gain} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100$$

5. Product recovery

Weight of chips prepared from 50g fresh banana slices was recorded in an electronic balance and product recovery was calculated.

$$\text{Yield} = \frac{\text{Weight of chips after frying}}{\text{Weight of slices before frying}} \times 100$$

Statistical Analysis:

The data was analyzed using suitable statistical techniques. The best treatments were selected by applying Kendall's coefficient of concordance.

RESULTS AND DISCUSSION

Preparation of Grand Naine banana chips

Two lots of Grand Naine banana chips were prepared. One lot was salted (T_1) and other was salted and spiced (T_2 - 3g pepper powder/100g, 1g salt with 100 ml water).

Salted chips Salted and spiced chips

Figure 2 - Salted and spiced chips (T_1 and T_2)

Organoleptic evaluations of prepared Grand Naine chips are presented in Figure 1. Organoleptic evaluation of Grand Naine chips is presented in table 1. The result reveals that both the treatments T_1 and T_2 were found to be acceptable with scores more than 7.5 in all organoleptic attributes. The treatment T_2 obtained a slightly higher score for taste (8.25) and crispiness (8.215) compared to T_1 (taste – 8.16, crispiness – 8.05). Molla (2009), reported a highly organoleptic score for Nendran banana chips with high scores of 7.70 (taste), 9.00 (crispiness), 7.10 (flavor) and 8.48 (overall acceptability).

Table 1: Organoleptic evaluation of Grand Naine chips

Treatments	Appearance	Colour	Flavour	Texture	Crispiness	Taste	Overall acceptability
T_1	7.76 (1.67)	7.56 (1.60)	7.9 (1.47)	7.93 (1.83)	8.05 (1.47)	8.16 (1.57)	7.98 (1.57)
T_2	7.6 (1.33)	7.56 (1.40)	7.95 (1.53)	7.95 (1.53)	8.215 (1.53)	8.25 (1.43)	7.98 (1.43)
W	.128	.086	.013	.556	.013	.027	.027

According to Lakshmi (2003), chips from different Nendran banana varieties were evaluated and have reported that chips prepared from Chengalikodan were found to be the best and chips prepared from Nedunendran scored the least. The organoleptic scores reveal that chips prepared from Grand Naine banana were on par with Nendran banana; hence the potential for commercialization of the product can be explored. Regarding appearance, T_1 (7.76) attained a slightly higher score compared to T_2 (7.6). Kendall's coefficient of concordance revealed a significant agreement among judges.

Chips prepared from Nendran banana are commonly available in our state but commercial production of chips from Grand Naine banana can also be exploited. Apart from this the market price of raw Nendran banana is almost double compared to Grand Naine banana, which assures a high BC ratio for the product.

Physical characteristics of prepared Grand Naine chips

Physical quality parameters like frying time, oil content, moisture content, weight gain, and product recovery was estimated using standard procedures. The frying time depends on the removal of water content. Moisture content in Grand Naine banana chips was observed as 5 % and required frying time was 4 minutes and 6 seconds. According to Sonia (2014), the frying time of Nendran banana was 5 minutes.

Agunbiade *et al,* (2006) reported that the fresh mature Grand Naine banana contains 75 % moisture and the fried chips had the moisture content of 5 % whereas the Nendran raw banana contains a moisture content of 67 % and 5.66 %. Molla *et al.* (2009) reported that the ordinary banana contains 4 % moisture content and frying time required was 3 minutes. Oil content of the chips should be low and hence the determination of the oil content is essential. The oil content of the prepared chips was found to be 38 – 39 % and the same oil content is reported in Nendran banana, (Molla *et al*., 2009)

The product recovery was estimated and found to be 40-gram chips from 100 gram of fresh Grand Naine banana. Adrika *et al.,* (2015) reported that the product recovery of Nendran banana contain70 g/100g high yield compared to Grand Naine banana.

Table 2: Physical characteristics of Grand Naine banana chips

Sl. no	Treatments	Frying time (Minutes)	Oil content (%)	Moisture content (%)	Product recovery (%)
1	T_1	4.6	38	5	40
2	T_2	4.6	39	5	40

Cost of Production

Cost of production of chips presented in Table 3. It was computed by taking into account the cost of raw banana, oil, other ingredients, fuel, and labour charges. It was compared with the cost of production of Nendran banana chips.

Compared to Grand Naine banana the price of raw Nendran is almost double with an existing market price of Rs 55-65/Kg for nendran banana and Rs 20-25/Kg for Grand Naine banana. The cost of production was Rs 188/Kg for Grand Naine banana.

Table 3: Cost of production

Chips	Amount (Rs/kg)
Nendran chips	240
T_1(Salted chips)	188
T_2 (Salted and spiced chips)	191

CONCLUSION

The preparation of Grand Naine banana chips (salted and spiced) was standardized. Both the treatments (salted and spiced chips) were found to be acceptable with scores more than 7.5 in all organoleptic attributes. Grand Naine banana was highly suitable for preparation of chips which definitely contributes to minimizing the post-harvest losses of banana. Production of banana chips is a suitable micro enterprise in rural areas and will help to fetch an additional income. The product cost is comparatively low for Grand Naine banana chips compared to Nendran chips. Hence there is a great scope for exploring the possibility of this value-added products in the field of processing. Further development has to be carried out for assessing the shelf life of the product.

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DEVELOPMENT AND ACCEPTABILITY OF JACKFRUIT BASED VERMICELLI

Ajisha K. H[1] and Dr. Sharon C. L[2]

Jackfruit (*Artocarpusheterophyllus Lam.*), the largest edible fruit in the world, it is a good source of vitamins, minerals and calories. However, the fruit is perishable and cannot be stored for a long time because of its inherent compositional and textural characteristics. In every year the considerable amount of jackfruit is wasted due to lack of processing methods (Mondal et al., 2013). So, the present work was undertaken to develop jackfruit based vermicelli and *payasam* and to analyze its sensory attributes. Based on the organoleptic evaluation, vermicelli prepared with 70 % raw jackfruit flour with 30 % whole wheat flour (both roasted and unroasted) was highly acceptable with the mean score of 7.95 and 7.86 respectively. The mean score of overall acceptability of *payasam* prepared with the roasted and unroasted vermicelli was 8.73 and 8.68. This indicates the feasibility of producing vermicelli with desirable organoleptic qualities from raw jackfruit flour.

Keywords: Jackfruit Flour, Vermicelli, Payasam, Sensory Attributes

INTRODUCTION

Jackfruit (*Artocarpusheterophyllus*) is commonly grown in the home gardens of tropical and subtropical countries. People consume it mostly as a fruit when ripe but also vegetable in the unripe stage. Jackfruit is a nutritious fruit rich in carbohydrate, protein, vitamins and minerals like potassium, calcium and iron. Along with nutrients, it contains an appreciable amount of isoflavones, phytonutrients and anti-oxidants (Lakshmana et al, 2013) and their health benefits are wide-ranging from anti-cancer to anti-hypertensive, anti-ageing, antioxidant and antiulcer (Omale and Friday, 2010).The flesh of the jackfruit is starchy and fibrous and is an excellent source of dietary fiber. Among the fruit crops seen in Kerala, jackfruit has a prominent position, which comes to 89702 hectares as reported in Farm Guide (2014). However, the fruit is perishable and cannot be stored for a long time because of its inherent compositional and textural characteristics. Every year considerable amounts of jackfruit are wasted due to lack of processing units and marketing.

Development of newer products from the underexploited fruits by the application of modern technology is essential to boost the miracle of our processing sector and these products can attract a wider spectrum of the consumer market (Srivastava and Sanjeev, 2002). An accelerated pace of modern life having greater awareness about health and preference for instant food items have made vermicelli very popular and an item of mass consumption in the category of extruded product. The market potential of jackfruit can be promoted if the fruits are made available to the consumer in a ready to eat or ready to cook form throughout the year.

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Moreover, it has become necessary to open new avenues for its better utilization, as traditional uses have already become stabilized. There lies a great opportunity for non-traditional uses of jackfruit in the form of convenience foods like vermicelli. Wheat is the major ingredient used for the preparation of extruded products like noodles, pasta etc. because of its special dough characteristic like cohesiveness (Uthayakumaran and Wrigley, 2010). The present study aims to develop new varieties of jackfruit flour incorporated vermicelli with improved nutritional and organoleptic qualities.

MATERIALS AND METHODS

Collection and preparation of ingredients

Raw jackfruit (*Artocarpusheterophyllus Lam.*) (koozha type), is collected from the kitchen garden and the flour was prepared as per the procedure suggested by Pandeay and Ukkuru (2004). The raw jackfruits were washed and separated into bulbs and seeds. The bulbs were sliced into 2.5×1 cm and then blanched in boiling water for 1 minute. The blanched slices were cooled and immersed in 0.2 % potassium metabisulphite (KMS) solution for 10 minutes. The immersed slices were then dried in a cabinet drier at 60^0c for 12 hours. The dried chips were milled into flour and sieved through 0.5 mm mesh and then packed in HDPE bag. Whole wheat flour and refined wheat flour were procured from the local market.

Preparation of vermicelli

Vermicelli was prepared as per the procedure of Ranganna et al. (2014). Vermicelli prepared with the combination of raw jackfruit flour and whole wheat flour (Table 1) and roasted jackfruit flour and roasted whole wheat flour (Table 2). The ingredients were mixed thoroughly and the dough was prepared with 30 % of water and kept for 30 minutes at room temperature. Through manual extruder, vermicelli was prepared and dried for 4 to 6 hours in the cabinet dryer. Control vermicelli also prepared by this procedure. After drying, vermicelli was packed in 250 gauge polyethylene pouches.

Table 1: Treatments for jackfruit incorporated vermicelli (unroasted flour)

Treatments	Combinations
T_0	Control (100% refined wheat flour vermicelli)
T_1	70% RJF + 30% WWF
T_2	60% RJF + 40% WWF
T_3	50% RJF + 50% WWF
T_4	40% RJF + 60% WWF

(RJF- Raw jackfruit flour, WWF – Whole wheat flour)

Table 2: Treatments for jackfruit incorporated vermicelli (roasted flour)

Treatments	Combinations
T_0	Control (100% refined wheat flour vermicelli)
T_1	70% RJF + 30% WWF
T_2	60% RJF + 40% WWF
T_3	50% RJF + 50% WWF
T_4	40% RJF + 60% WWF

(RJF- Raw jackfruit flour, WWF – Whole wheat flour)

Preparation of *payasam*

Payasam was prepared from all combinations of vermicelli. For the preparation of *payasam* 30gm of vermicelli was roasted and boiled with 300 ml of milk and 300 ml of water for 15 minutes. 40gm of sugar and one pinch crushed cardamom was added in all the treatments.

Organoleptic evaluation

The sensory evaluation was carried out for the prepared vermicelli and *payasam* using a nine-point hedonic scale with a panel of 15 trained judges considering the 6 sensory parameters (appearance, colour, flavor, texture, taste and overall acceptability).

Statistical analysis of the data

The observations recorded were tabulated and data was analyzed by using Completely Randomized Design (CRD). The scores obtained for organoleptic evaluation were evaluated by Kendall's Coefficient of Concordance (W).

RESULT AND DISCUSSION

Organoleptic evaluation

Jackfruit based vermicelli (both unroasted and roasted flours) were subjected to sensory evaluation and results are represented in table 3 and 5. *Payasam* prepared from jackfruit based vermicelli was undergoing organoleptic evaluation and results are shown in table 4 and 6.

Table 3 and 4; show that all treatments were significant at 1 %. The mean scores for sensory parameters (appearance, colour, flavour, texture, taste and overall acceptability) of jackfruit based vermicelli and *payasam* was highest for treatment T_1 (70 % raw jackfruit flour incorporated vermicelli). The mean score for taste (8.71) and texture (8.62) of jackfruit based vermicelli was significantly low when compared to control. The data revealed that colour, flavour, taste, texture and overall acceptability of *payasam* were higher for treatment T_1. Significant agreement (Kendall's value) among judges was observed for the different quality attributes of *payasam* prepared using roasted jackfruit and roasted wheat flour vermicelli.

Kumari et al. (2016) developed raw jackfruit based noodles by mixing refined flour, bulb flour and seed flour and the combination 50:10:40 and 50:20:30 were found to be highly acceptable and the results of study indicated that samples of jackfruit bulb and seed flour added noodles contained more protein, fiber and minerals and less in energy and carbohydrate as compared to control sample.

The table 5 and 6 reveal that jackfruit based vermicelli and *payasam* with 70 % incorporation of roasted jackfruit flour and 30 % roasted whole wheat flour was acceptable and had a higher mean score for the quality attributes namely flavour, taste, texture and overall acceptability. Roasting of flours enhances the colour and texture of products. As a result of roasting, smaller units of starch called dextrins are formed and are easily digested by the body (Srilakshmi, 2010). The jackfruit vermicelli and *payasam* prepared from roasted jackfruit flour were highly acceptable compared to vermicelli and *payasam* prepared from unroasted jackfruit flour in terms of all sensory attributes. Refined wheat flour contains a high amount of carbohydrate but fewer amounts of other nutrients. Intake of refined wheat flour elevates the blood sugar level due to the easy absorption of carbohydrate in it, which in turn can lead to obesity and diabetes (Banu and Sasikala, 2012). Vermicelli made from jackfruit flour and wheat flour, rich in fiber content (2.2 %) may eliminate these complications.

Table3: Mean score for organoleptic evaluation of jackfruit based raw vermicelli (unroasted flour) and control

Treatments	Sensory parameters					
	Appearance	**Colour**	**Flavor**	**Taste**	**Texture**	**Overall acceptability**
T_0	8.44 (3.60)	8.44 (3.83)	8.82 (4.07)	8.35 (3.70)	8.4 (3.90)	8.37 (3.90)
T_1	8.2 (3.40)	8.08 (3.10)	8.34 (2.90)	7.91 (3.00)	7.86 (2.90)	7.86 (2.83)
T_2	7.97 (3.03)	7.88 (2.60)	8.24 (2.80)	7.88 (2.73)	7.8 (2.83)	7.84 (2.80)
T_3	7.84 (2.53)	7.8 (2.73)	8.28 (2.60)	7.86 (3.00)	7.82 (2.67)	7.68 (2.80)
T_4	7.62 (2.43)	7.73 (2.73)	8.13 (2.63)	7.75 (2.57)	7.8 (2.70)	7.66 (2.67)
Kendalls W	.117**	.109**	.207**	.083**	.120**	.111**

Value in parentheses is mean rank score based on Kendall's W which was significance **Significance at 1 % level

Table 4: Mean score for organoleptic evaluation of jackfruit based *payasam* (unroasted flour) and control

Treatments	Sensory parameters					
	Appearance	Colour	Flavor	Taste	Texture	Overall Acceptability
T_0	8.51 (3.53)	8.51 (3.53)	8.48 (3.77)	8.71 (4.40)	8.62 (3.80)	8.75 (4.07)
T_1	8.64 (3.83)	8.64 (4.17)	8.6 (4.00)	8.48 (3.43)	8.51 (3.60)	8.68 (3.87)
T_2	8.35 (2.80)	8.17 (2.53)	8.04 (1.97)	8.04 (2.47)	8.17 (2.73)	8.22 (2.40)
T_3	8.06 (2.17)	8.02 (2.30)	8.33 (2.80)	8.02 (2.40)	8.06 (2.57)	8.08 (1.93)
T_4	8.24 (2.67)	7.95 (2.47)	8.2 (2.47)	8.08 (2.30)	8.02 (2.30)	8.31 (2.73)
Kendalls W	.199**	.289**	.320**	.374**	.199**	.405**

Value in parentheses is mean rank score based on Kendall's W which was significance **Significance at 1 % level

Table 5: Mean score for organoleptic evaluation of jackfruit based raw vermicelli (roasted flour) and control

Treatments	Sensory parameters					
	Appearance	Colour	Flavor	Taste	Texture	Overall Acceptability
T_0	8.4 (3.37)	8.44 (3.73)	8.84 (3.87)	8.4 (3.77)	8.44 (3.80)	8.37 (3.77)
T_1	8.35 (3.47)	8.26 (3.30)	8.35 (2.97)	8.02 (3.03)	7.88 (3.00)	7.95 (3.00)
T_2	8.06 (2.97)	7.93 (2.53)	8.31 (2.70)	7.91 (2.83)	7.84 (2.89)	7.86 (2.63)
T_3	7.97 (2.73)	7.91 (2.77)	8.33 (2.70)	7.88 (2.87)	7.8 (2.77)	7.8 (2.70)
T_4	7.71 (2.47)	7.84 (2.67)	8.24 (2.77)	7.77 (2.50)	7.82 (2.60)	7.93 (2.90)
Kendalls W	.076**	.114**	.123**	.101**	.099**	.095**

Value in parentheses is mean rank score based on Kendall's W which was significance **Significance at 1 % level

Table 6: Mean score for organoleptic evaluation of jackfruit based *payasam* (roasted flour) and control

Treatments	Sensory parameters					
	Appearance	**Colour**	**Flavor**	**Taste**	**Texture**	**Overall Acceptability**
T_0	8.53 (2.93)	8.68 (3.67)	8.33 (2.70)	8.35 (3.67)	8.46 (3.73)	8.51 (3.30)
T_1	8.79 (4.07)	8.74 (4.03)	8.66 (4.10)	8.66 (3.97)	8.55 (3.90)	8.73 (3.97)
T_2	8.46 (2.83)	8.28 (2.70)	8.35 (2.63)	8.35 (2.87)	8.31 (3.10)	8.53 (3.00)
T_3	8.59 (2.93)	8.24 (2.57)	8.44 (2.87)	8.33 (2.63)	8.48 (2.50)	8.35 (2.47)
T_4	8.42 (2.23)	8.08 (2.03)	8.46 (2.70)	8.2 (1.87)	8.26 (1.77)	8.26 (2.27)
Kendalls W	.207**	.324**	.179**	.358**	.388**	.210**

Value in parentheses is mean rank score based on Kendall's W which was significance **Significance at 1 % level

CONCLUSION

The study concluded that 70 % incorporation of jackfruit based vermicelli (both roasted and unroasted) was acceptable in all the sensory qualities. This jackfruit vermicelli can be a good source of instant food for all age group people. It also highlights the future prospects and strategy for jackfruit production and utilization.

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EVALUATION OF PHYSICOCHEMICAL PROPERTIES OF CLEOME VISCOSA SEED OIL AND IN VITRO IRON BIOAVAILABILITY OF DEFATTED SEED CAKE

Soni Bisht[1]and Dr. Sarita Srivastava[2]

Cleome viscosa (*Jakhya*) is weed which is found all over India and used in Uttarakhand for culinary purposes. The present study was carried out to estimate the physicochemical properties of oil of less utilized Cleome viscosa seed of Uttarakhand state. Crude fat of the seeds, physicochemical properties like specific gravity, refractive index, colour, saponification value, acid value, peroxide value and the iodine value of the seed oil were estimated. Its seed oil is rich in polyunsaturated fatty acid (omega-six fatty acid). Crude fat of seeds of Cleome viscosa was estimated by the method prescribed by AOAC, (1990), estimation of specific gravity, the refractive index was done by the method given by Raghuramulu et al., (2003) while other physicochemical properties were evaluated by the method of FSSAI, (2015). In vitro iron bioavailability of defatted seed cake of Cleome viscose was evaluated by the method given by Rao and Prabhavati, (1988). Results of the study revealed that Cleome viscosa seeds contained 26.8±0.78g/100g crude fat. Refractive index of seed oil was found to be 1.49±0.001, whereas saponification value of seed oil was found to be 197±0.14. The observed acid value of seed oil was found to be 3.30±0.17.Further, the ionizable iron content of defatted seed cake of Cleome viscose was found not very high i.e. 0.38mg/100g whereas ionizable iron expressed as percent of total iron was found 0.49mg/100g.

Keywords: Cleome Viscosa, Ionizable Iron, Saponification, Acid Value, Physicochemical, In-Vitro

INTRODUCTION

Oils and fats obtained from unconventional sources are used for human consumption in limited areas where they are grown and are known as minor oils. Localized shortage of traditional edible oils and search for oil sources having more nutritional value has focused attention on these oils in recent times. Underutilized Seeds possess nutritive and calorific values. The oil obtained from the underutilized seeds can be of higher nutritional and therapeutic values. The amount of energy provided by 1g of fat/oil when fully digested is more than twice as many calories as do carbohydrates and proteins. Cleome viscosa is one such weed and member of Capparadaceae family found all over India including Uttarakhand. It is also known as wild mustard or dog mustard. (Satyavathi et al., 1976)Seeds of this plant resemble mustard seeds and are rich in oil content. Cleome viscosa is known as Jakhya in Uttarakhand state. It grows at altitudes from 500 to 1500 meters naturally in abandoned fields. Cleome viscosa seeds are a good source of vitamin C and iron. The seeds are rich in omega six fatty (linoleic acid) and phytosterol-1.37 mg% and have been reported to be devoid of any toxic effect in rats on sub-chronic feeding. (Rukmini, 1978)

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Cleome viscosa seed oil has the potential to be explored in order to get an alternative source of polyunsaturated fatty acids such as linoleic acid which is essential fatty acid since it cannot be synthesized by our body and has to be taken from dietary supplements.

Thus considering the above important aspects of Cleome viscosa seeds, the present study was planned to analyze the physicochemical properties of the seed oil and in vitro iron bioavailability of its defatted seed cake which can be helpful in establishing the alternative source of edible oil having high nutritional value as well as a source of iron-rich feed for animals. The present study has been undertaken with following objectives:

- Evaluation of physicochemical characteristics of Cleome viscosa seed oil.
- Evaluation of ionizable iron and in vitro iron bioavailability of defatted seed cake of Cleome viscosa.

MATERIALS AND METHODS

Location of the study: Department of Foods and Nutrition, College of Home Science, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand.

Availability and preparation of seeds

Seeds of Cleome viscosa for the study were obtained from Nainital district of Uttarakhand state. Impurities like stones, unsound kernels were removed by sifting and winnowing.

Estimation of crude fat and extraction of oil

Crude fat of seeds of Cleome viscosa was estimated by the method prescribed by AOAC, 1990 and extraction of oil was done by solvent extraction using petroleum ether as solvent and soxhlet apparatus for extraction.

Estimation of physicochemical characteristics of seed oil

Physicochemical characteristics like specific gravity, the refractive index of the oil were analyzed by the method given by Raghuramulu et al., 2003, whereas colour was ascertained by visual examination. Besides these, saponification value, acid value, peroxide value and iodine value of Cleome viscosa seed oil were determined by methods given by FSSAI, 2015.

Evaluation of in vitro iron bioavailability of defatted seed cake of Cleome viscosa

It was evaluated by method given by Rao and Prabhavati, 1988 and in vitro available iron is calculated by following equation: $Y= 0.4827+0.4707X$

Where Y= % in vitro available iron, X= Ionizable iron

RESULTS AND DISCUSSION

The crude fat content of Cleome viscosa seeds was found to be 26.8±0.78g/100g. Regarding the physicochemical characteristics, the oil obtained from Cleome viscosa had a dark green colour upon visual comparison with other oils. In support of the present study, Rukmini et al., (1982) also reported that dark green colour of oil of Cleome viscosa seeds may be due to high tocopherol content. Refractive index of seed oil was found to be 1.49±0.001 which was more than crude ground nut oil's refractive index which is 1.462 (Table 1). The specific gravity of Cleome viscosa seed oil at 30ºC was observed to be 0.933±0.02. Saponification value of seed oil was 197±0.14 mg KOH/g. It was more than that of crude groundnut oil which has a value of 192 mg KOH/g. The observed acid value of seed oil was found to be 3.30±0.17 mg KOH/g which was slightly more than acid value of crude groundnut oil (2.890 mg KOH/g) (Table 1).

Table 1: Physicochemical properties of Cleome viscosa seed oil

Physicochemical properties	Cleome viscosa seed oil (crude)	Ground nut oil (crude)*
Colour	Dark green	-
Refractive index	1.49±0.001	1.462
Specific gravity (at 30ºC)	0.933±0.02	0.916
Saponification value (mg KOH/g)	197±0.14	192
Acid value (mg KOH/g)	3.30±0.17	2.89
Peroxide value (meq/100g)	2.92±0.06	2.36
Iodine value (g/100g)	94.56±1.56	91

All results are mean ±SD for 3 determinations.* - Aluyor et al., 2009

According to Deman (1990), the acid value is used to measure the extent to which glyceride in oil has been decomposed by lipase and other actions such as light and heat and that its determination is often used as a general indicator of the condition and edibility of oils. Aluyor et al, 2009 reported that free fatty acid of oil suitable for edibility purpose should not exceed 5%. Furthermore, the peroxide value and iodine value in Cleome viscosa seed oil were analyzed as 2.92±0.06 meq/100g and 94.56±1.56 g/100g respectively. The high peroxide value in crude oil might be as a result of the effect of moisture, atmospheric oxygen and light on the oils leading to a progressive increase in the peroxide value whereas the high iodine value indicates dehydrogenation. It is a measure of unsaturation in lipid, which again determines the degree of flow.

With respect to the ionizable iron content of defatted seed cake of Cleome viscosa, it was found not very high i.e. 0.38 mg/100g (Table 2). Whereas ionizable iron expressed as percent of total iron was found 0.49mg/100g. The content of in vitro available iron in defatted seed cake was found 0.66 and value expressed in percent of total iron was 0.84. The low values of in vitro available iron may be due to phytates, tannic acid, polyphenols all of which form insoluble complexes with iron at pH 7.0 and inhibit its absorption. Thus a further study is required to elaborate these anti-nutritional factors in C. viscosa seeds.

Table 2: Ionisable iron, in vitro available iron of defatted Cleome viscosa seed cake

Ionisable iron	Defatted seed cake of Cleome viscosa
Total iron (mg/100g)*	78.00
Ionizable iron (mg/100g)	0.38±0.03
Ionizable iron (% of total iron)	0.49±0.68
In vitro available iron (%)	0.66±0.61
In vitro available iron (% of total iron)	0.84±0.91

All results are mean ±SD for 3 determinations.*- Rukmini and Deosthale, 1979

SUMMARY AND CONCLUSION

Thus on the basis of the results, Cleome viscose seed oil can be a good alternative source of polyunsaturated fatty acids and reported to be edible. Its seeds can be a good alternative to cumin seeds and provide three times higher yield when maintained by the farmers as a pure crop compared to yield obtained in mixed cropping conditions. Ionizable iron content of defatted seed cake of Cleome viscosa was found more than that of rice, whole pulses like Bengal gram, black gram, lentil and equal to that of finger millet.

CONFLICT OF INTEREST:

Authors declare that there are no conflicts of interest exist.

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A STUDY ON THE DEMOGRAPHIC PROFILE, PHYSICAL ACTIVITY AND DIETARY PATTERN OF MEN WITH METABOLIC SYNDROME

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Diet and nutrition are important factors in the promotion and maintenance of good health throughout the course of life. Rapid changes in the dietary patterns and physical activity are risk behaviors affecting disease pattern globally. The study is exploratory research and the subjects were selected based on purposive sampling technique. Three hundred and eighty men in the age group of 25 to 50 years were screened for metabolic syndrome using the National Cholesterol Education Program Adult Treatment Panel III Criteria. The initial height, body weight, waist circumference and hip circumference, body fat and blood pressure levels were measured and recorded. A total of eighty male subjects with metabolic syndrome were diagnosed with metabolic syndrome and the information regarding the socio-demographic profile, family medical history, personal habits and food consumption pattern of all the selected subjects were obtained through a validated questionnaire. Results of the study indicated an advancing trend in metabolic syndrome as the age increased. The majority (98.8 %) was sedentary workers and belonged to high-income group. About 73.8 % of the subjects had the habit of smoking and 50 % of the subjects chewed tobacco. Alcohol consumption was common among 73.7 % of the subjects. Sleep apnea was found in 81 % of the subjects. Consumption of sweetened beverages, meat, fried items and preserved foods were common among the subjects. Egg and full-fat milk are consumed by more than 80 % of the subjects. Healthy lifestyles particularly changing behavior in food habits and physical activity will prolong life expectancy and improve the quality of life. This will favor a decrease in the morbidity and mortality from chronic diseases such as diabetes and cardiovascular diseases.

Keywords: Metabolic Syndrome, Dietary Habits, Sedentary Activity, Healthy Lifestyle

INTRODUCTION

Metabolic Syndrome is the most important public threat of the 21st century. It is characterized by a cluster of metabolic risk factors and eventually these risk factors increase the risk of chronic diseases. The prevalence of metabolic syndrome is affecting almost one-fourth of the global adult population and has become a major public health problem worldwide. The metabolic risk components separately increase the risk of diabetes mellitus, cardiovascular disease, and all-cause mortality (Zimmet et al., 2001). Metabolic syndrome depends on a complex interaction between genetic factors, physical activity, and dietary patterns. It is firmly established that diet can influence each of the factors that is clustering in the metabolic syndrome. Diet counseling to change health behaviors will decrease the incidence of metabolic syndrome in developing countries.

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Studies in India showed that amongst males, the prevalence increased proportionately after 30 years of age and reached a maximum in the 50–59 age groups (Kanjilal et al., 2008). Studies on the prevalence of metabolic syndrome in India revealed that metabolic syndrome increased with age and was found to be higher in men than in women (Thiruvagounder et al., 2010). Hence; this research aims to study the demographic profile, physical activity and dietary pattern of men suffering from metabolic syndrome. The research results will be a landmark and will help to identify the risk factors associated with metabolic syndrome and will serve as a basis to develop evidence-based strategies towards a healthy metabolic profile and the dietary pattern of the individuals with metabolic syndrome in the Indian population.

The objectives of the study are to elicit information with regard to the age, educational status, occupation and income level, personal habits, family medical history, and physical activity pattern and to study the food consumption pattern and dietary pattern of the subjects with metabolic syndrome using a validated questionnaire.

MATERIALS AND METHODS

Design of the Study

The study is an exploratory research.

Selection of the Sample

The study was carried out on men with metabolic syndrome residing in Chennai. The subjects were selected based on purposive sampling technique. Participants willing to take part in the study were invited to attend a screening. The subjects were requested to report in the morning between 8.00 and 9.00 a.m. after a twelve-hour fasting. The initial height, body weight, waist circumference and hip circumference, body fat, and blood pressure levels were measured and recorded. Ten milliliters of blood sample was drawn using sterile vacupets by a qualified technician and transferred to SST tubes and in tubes containing EDTA as the anticoagulant. Serum and plasma separated from the blood samples were used to carry out the biochemical analyses. The glucose tolerance test was also done to identify subjects with pre-existing diabetes. Analyses of all the biochemical parameters were carried out by the Ranbaxy Laboratories, Chennai on the day of blood collection.

Subjects diagnosed with metabolic syndrome as per the NCEP ATP III diagnostic criteria were selected for the study. Information regarding the demographic profile, family medical history, personal habits and food consumption pattern of all the selected subjects was obtained through a validated questionnaire. The subjects were classified according to the different sector in which they worked and the type of activity was determined based on the occupation of the subjects as given by Gopalan et al. (2004). Three hundred and eighty men in the age group of 25 to 50 years were screened for metabolic syndrome using the National Cholesterol Education Program Adult Treatment Panel III Criteria (2001), given in Table 1. A total of eighty male subjects with metabolic syndrome were identified and were selected for the study.

Table 1: Diagnostic Criteria for Metabolic Syndrome

Waist circumference (Men)	> 102 cm (>40 in)
Plasma triglyceride concentration	≥ 150 mg/dL
Serum HDL-cholesterol	< 40 mg/dL
Blood pressure	≥ 130/85 mm Hg
Fasting plasma glucose	≥ 100 mg/dL

The study was carried out at the Centre for Nutrition - Counseling, Research and Extension activities, Department of Home Science, Women's Christian College, Chennai. The selected subjects were requested to report at the Centre to register for the study, for obtaining information regarding the demographic profile, family medical history, personal habits and food consumption pattern through a validated questionnaire and for assessing the parameters. Individual counseling was given to all the subjects after the study period. The dietary guidelines given to the individuals were to include a greater variety of food in the diet and to ensure a balanced diet.

Ethics Committee Approval

The study protocol was approved by the Institutional Ethics Committee of the Women's Christian College, Chennai. The objectives and the study protocol were explained in detail to the subjects. A written informed consent was obtained from each one of the subjects willing to participate in the study.

RESULTS AND DISCUSSION

The data regarding the age, educational qualification, occupation, income levels, family medical history, and personal habits such as the use of tobacco, consumption of alcohol, physical activity as well as the dietary pattern of the subjects were collected using an interview schedule. The data collected was processed, tabulated, and subjected to descriptive analysis. The results of the study have been discussed under the following headings:

General Information about the Subjects

The percentage distribution of the subjects according to the different age, educational qualification, type of activity, income levels groups are given in table 2.

Table 2: General Information about the Subjects

Age group (year)	Number	Percent
25 to 30	1	1.3
31 to 35	7	8.8
36 to 40	17	21.3
41 to 45	35	43.8
46 to 50	20	25.0

Educational qualification	**Number**	**Percent**
Diploma	40	50.0
Graduate	22	27.5
Post graduate/professional	18	22.5
Type of activity	**Number**	**Percent**
Sedentary	79	98.8
Moderate	1	1.2
Heavy	-	-
Income Levels	**Number**	**Percent**
Very low income	Nil	Nil
Low income	Nil	Nil
Middle income	Nil	Nil
High income	80	100.0

The results showed a regular increasing trend in metabolic syndrome as the age advanced excepting in the 46 to 50 years age group. The results showed a regular increasing trend in metabolic syndrome as the age advanced excepting in the 46 to 50 years age group. Studies have shown an increased prevalence of metabolic syndrome as the age increased (Hildrum et al., 2007; Ford et al., 2002; Gupta et al., 2004). The Asian Indians are associated with an increased risk of diabetes after the age of 45 and that may be the reason that prevalence of metabolic syndrome reduced after the age of 46 in the present study. It can be ascertained that a lifetime accumulation of adversities including over nutrition, a sedentary lifestyle, obesity and dyslipidemia, changes in the hormones, untreated hypertension, changes in the functioning of beta cells and other environmental and physiological factors may trigger a genetic expression of metabolic syndrome which becomes more prominent with biological maturation.

Results showed that majority (50%) of the subjects were diploma holders. Graduates and postgraduate or professionals were found to be 27.5 % and 22.5 % respectively. The level of education was found to be inversely related to metabolic syndrome. The reasons for this association might be related to the influence of education in predicting food choices and healthy behaviors, both of which are related to metabolic syndrome. Educational achievements play an important role in the adult socioeconomic position and development of risk of metabolic syndrome. Erem et al. (2008) reported a negative association between education level and prevalence of metabolic syndrome.

Majority of the subjects (98.8%) were sedentary workers and were in the high-income category. It is well documented that sedentary lifestyle is one of the major cause of chronic diseases, and metabolic syndrome is the precursor of chronic diseases. Studies have shown that sedentary lifestyle promotes metabolic syndrome (Lakka and Laakesonen, 2007; Ford, 2005; Sisson et al., 2009). With regard to income levels, increased household income increases the risk of metabolic syndrome.

One possible explanation for this finding is that men in the high-income group care less for healthy food choices, they eat out frequently and choose high fat and high energy-dense food, which favour an increased prevalence of metabolic syndrome. Household income is a social and economic indicator associated with health behaviors that result in a higher risk of metabolic syndrome.

About 73.8 % of the subjects had the habit of smoking, 50 % chewed tobacco and 73.7 % of the subjects have the habit of smoking every day. Cigarette smoking is a public health challenge. Chronic smoking is associated with the prevalence of metabolic syndrome. (Oh et al., 2005; Kim et al., 2010) Heavy alcohol consumption is related to the aggravation of metabolic profiles such as triacylglycerol, blood pressure, and blood glucose.

Sleep apnea is present among the majority (81.2%) of the subjects; Sleep apnea is a manifestation of metabolic syndrome. There is a strong association of sleep apnea with obesity and male gender. Previous studies by Coughlin et al. (2004) and Kono et al. (2007) have demonstrated that obstructive sleep apnea is independently associated with a number of cardiovascular risk factors such as hypertension, insulin resistance, impaired glucose tolerance, and dyslipidemia.

Family History of Diseases

Results in table 3 revealed that family history of type 2 diabetes, hypertension and CVD were common among the parents of the subjects. Medical and lifestyle risk factors that aggregate in families include dyslipidemia, hypertension, obesity, hyperfibrinogenemia, diabetes mellitus, smoking habits, eating patterns, alcohol consumption, physical inactivity, and socioeconomic status and are related to metabolic syndrome. Isomaa et al. (2001) reported that cardiovascular and overall mortality was higher in 35- 70-year-old individuals with a family history of type 2 diabetes and metabolic syndrome.

Table 3: Percentage distribution of subjects based on the family medical history

Medical History	Father		Mother		Grandfather		Grandmother		Brother/ Sister		None	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Diabetes												
Type 1	14	17.5	13	16.3	5	6.3	1	1.3	1	1.3	46	57.5
Type 2	18	22.5	19	23.8	3	3.8	2	2.3	0	0	38	47.5
Hypertension	12	15.0	9	11.3	7	8.8	1	1.3	1	1.3	50	62.5
CVD	12	15.0	7	8.8	0	0	0	0	1	1.3	60	75.0
Kidney disease	3	3.8	6	7.5	2	2.5	1	1.3	0	0	68	85.0
Cancer	3	3.8	5	6.3	1	1.3	1	1.3	0	0	70	87.5
Stroke	3	3.8	0	0	0	0	1	1.3	0	0	76	95.0

Physical Activity

As mentioned in table 4, the subjects were not involved much in physical activity. Energy expenditure affects all five components of the metabolic syndrome and it is inversely associated with body weight, blood pressure, and concentrations of triglycerides and glucose and is directly associated with the concentration of high-density lipoprotein cholesterol. People who spend considerable time pursuing sedentary activities are likely to have an unfavorable energy balance with untoward effects on the five components of the metabolic syndrome. Physical inactivity is inversely associated with metabolic syndrome incidence in women and men (Mohan et al., 2005). Furthermore, men in the high-income group have a less physical activity that might lead them to develop metabolic syndrome.

Table 4: Percentage distribution of subjects based on the type of physical activity (n=80)

Type of physical activity	Daily		Weekly		Rarely	
	No.	%	No.	%	No.	%
Brisk walking	18	45.0	2	5.0	20	50.0
Yoga	1	2.5	1	2.5	38	95.0
Jogging/cycling	1	2.5	-	-	39	97.5
Swimming	-	-	2	5.0	38	95.0

Food Consumption Pattern

Among the cereals, rice was the staple cereal consumed by 81% of the subjects, and 53.8% of the subjects consumed wheat daily. High fiber foods such as Oats (98.8%) and minor millets (86.3%) were consumed by a majority of the subjects. Pulses like red gram, Bengal gram, and roasted Bengal gram dhal were consumed daily by most of the subjects. Green leafy vegetables which are rich sources of beta-carotene, vitamin C and fiber were consumed by very few of the subjects daily. Onions and tomatoes being the basic ingredients in Indian cuisine were used every day in cooking by all the subjects. Locally grown vegetables such as lady's finger, cucumber, and bitter gourd were consumed once in a week by most subjects. Among the fruits, bananas were the most frequently consumed fruit compared to any other fruit. Flesh foods such as chicken were consumed daily by 51.3% of the subjects whereas fish was consumed rarely. Eggs were consumed daily by 86.3% and milk by 85% of the subjects daily. Very few consumed milk products such as cheese and curd daily. Sunflower seed oil is the most widely used cooking oil and 96.3% of them used it daily. Sugar was consumed on a daily basis by all the subjects.

Dietary Habits of the Subjects

Almost 93% of the subjects were non-vegetarians and only 5% of the subjects were vegetarians. A majority of the subjects consumed fried items such as vadai, bajji and samosas. These fried foods are consumed during leisure time or as snack items. Majority (63.8%) of the subjects consumed preserved food items like vadams, vathals and pickles on a regular basis. Processed foods such as jams, jellies and sauces were consumed by 43.8% of the subjects daily. 81 % of the subjects consumed pasta and noodles frequently.

A majority (47.5%) of the subjects consumed cakes and biscuits weekly and 32.5% of the subjects consumed daily. A similar trend was observed for the consumption of bread, bun and puff pastry where 48.8% of the subjects consumed them at least once a week. Breakfast (73.8%) and dinner (87.5%) are consumed at home. Snacks (62.5%) and lunch (51.3%) were eaten at the office cafeteria or in the restaurants outside the working premises. Subjects preferred to eat vegetables, meat, fish which were shallowly fried, whereas roots and tubers like potatoes, yam were consumed as deep fat fried items. Nuts in the raw form were consumed rarely by most of the subjects but were used as garnishes in various preparations. Sweetened beverages like squash, rasna (powder drink) and iced tea were consumed by 70% daily, and aerated drinks by 56.3% of the subjects rarely.

Due to acculturation, the dietary habits of Indians are rapidly changing. The Adventist Health Study 2 reported that vegetarians and semi-vegetarians had a lower risk for metabolic syndrome when compared to non-vegetarians (Rizzo et al., 2010). A higher intake of the bakery products was associated with a greater risk of the metabolic syndrome. Consumption of bakery products should be moderate, and priority is given to consumption of low-fat, low-sugar milk products in order to prevent chronic diseases (Rodriguez-Artalejo et al., 2003). Pereira et al. (2005) reported that subjects who ate fried foods are more prone to metabolic syndrome. Processed foods are high in sodium content. A diet with an excessive salt intake can elevate the blood pressure. An optimal diet for metabolic syndrome includes a low salt content (Riccardi and Rivellese, 2000).Trans fatty acids are found in fried foods, fast-foods, packaged snack foods, and commercially baked or processed foods such as cookies, crackers, chips, artificial creamers, vegetable shortening, and margarine. They increase LDL-C levels and they also lower HDL-C levels and this eventually increases the risk of metabolic syndrome leading to cardiovascular disease.

Metabolic Risk Component among Subjects with the Metabolic Syndrome

From table 5 it can be noted that there was significant age-related increase in the prevalence. Among the components of metabolic syndrome, large waist circumference is highly prevalent in adults (68.66 %) in the age group of 40 -45 years. The second most prevalent metabolic risk is HDL-C. Almost 69 % of the subjects had low HDL-C and this risk component was found to be highest in subjects in the age group of 40-45 years.

High blood pressure, Triglycerides and impaired fasting blood glucose were prevalent in the adults in the age group for 40-45 years. This is line with an Indian Urban study done by Gupta et al. (2004) which showed that the prevalence increases with age and there is greater prevalence in subjects with large waist circumference followed by low HDL cholesterol and high triglycerides and impaired fasting glucose. The high prevalence of metabolic syndrome in the present study was not primarily due to a high prevalence of glucose intolerance but rather by enlarged waist circumference combined with dyslipidemia.

Table 5: Age – Adjusted Prevalence of Metabolic Risk Component among the Subjects with the Metabolic Syndrome

Metabolic syndrome components	Percentage Distribution Of The Subjects				
	25-30 years	**30-35 years**	**35-40 years**	**40-45 years**	**45-50 years**
Large waist circumference	3.33	12.6	28.0	68.66	19.33
High BP	3.33	9.3	22.0	51.33	27.33
High Fasting Blood glucose level	3.33	5.33	7.33	19.33	8.66
High Triglyceride	2.0	10.0	35.33	52.0	28.66
Low HDL	3.33	6	28	68.66	34.66

CONCLUSION

In conclusion, the current findings indicate that a dietary pattern characterized by increased consumption of legumes is associated with reduced risk of insulin resistance and the metabolic. In contrast, a dietary pattern with high amounts of refined grains, red meat, butter, processed meat, and high-fat dairy products and low amounts of vegetables and low-fat dairy products is associated with a greater risk of the metabolic syndrome. Food intake is a primary factor of obesity and thereby metabolic syndrome but regular exercise and proper food intake is a key factor for prevention and treatment of metabolic syndrome, Present study suggests that faulty diet and exercise may be the primary risk factor contributing to risk factors associated with metabolic syndrome. Proper exercise and diet could help in the reducing the prevalence of metabolic syndrome among Indian men.

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GARDEN BASED NUTRITION INTERVENTION IMPROVES FRUIT AND VEGETABLE CONSUMPTION AMONG SCHOOL CHILDREN

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The objective of the present study is to investigate whether nutrition education, gardening and nutrition games, when supplemented in nutrition intervention can improve in the consumption of fruits & vegetables among the school going children. One hundred adolescents of the age group of 10-12 years from the two schools were selected for this study. Nutrition intervention was carried out which included imparting nutrition education using multimedia, nutrition games and school gardening. To assess the consumption of fruits and vegetables, evaluation was conducted before and after nutrition intervention. Statistically significant differences were seen between pre and post-test score. All the subjects of the current study were habitual non-vegetarians. The results revealed that most of the food items were recorded very low-frequency score with regard to consumption before the intervention. Before intervention, the actual intake of fruits was 60g per day and the vegetable consumption was 66.2g per day. After the intervention programme, it was seen that fruit consumption increased to 80g per day and vegetable consumption increased to 88.5g per day. The current study reveals that nutrition education using multimedia approach supplemented with gardening and games had a positive effect on the consumption of fruits and vegetables.

Keywords: Garden-Based, Nutrition Intervention, Consumption, School Gardening, Fruits and Vegetables

INTRODUCTION

It is during the childhood, the food preferences and dietary habitats are established. Therefore it is always ideal to target at young children to impact intervention while they are forming their lifelong habits. (Kraft, 2016) In recent years garden-based intervention in schools has received attention as a way to impart nutrition education. Several studies show that garden based intervention has benefited in several ways which include promotion of sharing, mental health activity, increased willingness to go school, moral development, youth crime prevention, healing and therapy, increased produce accessibility and enjoyment of nature. (Ferris et al, 2001 & Armstrong 2000)

Most of the benefit of consuming fruits and vegetables come from a reduction in cardiovascular diseases; they can also prevent cancer. (WHO, 2013) Recent studies have shown that the consumption of fruits and vegetables among school children are inadequate and the trend of junk food eating habit is increasing alarmingly. (Unnithan, 2008) Hence methods to increase the consumption of fruits and vegetables among children are to be developed. So as ensure the nutrition health of the adolescents in Kerala. There are many ways to teach nutrition and this study focused on a hand on nutrition education

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combined with gardening and multimedia tools. The objective of the present study is to find out the impact of garden-based nutrition intervention on the consumption of fruits and vegetables among the school going children.

MATERIALS AND METHODS

Locale of the study

Government Upper Primary School, Ambalathara and Government Modern Higher Secondary School, Venganoor, Thiruvananthapuram were selected as the locale of the study. These schools were selected so as to represent an urban and a rural school respectively.

Selection of the sample

In the present study, the sample comprised of fifty school children both boys and girls in the age group of 10-12 years. The children were selected from each of two schools, one rural and one urban School. The total of 100 children who formed the subjects for the nutrition intervention programme was selected using purposive sampling method. Purposive sampling method was selected as sampling technique in the present study because it was an action research conducted in a school and children of the same class has to be selected, for conducting the nutrition intervention.

Assessment tools for data collection

The success of every research study depends upon the use of appropriate and well-designed tools or technique to elicit information from the sample and the following tools were used in the present study for assessment.

Tool 1: Food consumption pattern of the subjects – Specially prepared rating scale

The frequency of use of fruits and vegetables rating scale: Frequency of use of different food items in the diet of the respondents clearly indicated the adequacy of the diets consumed by them. In this study, food use frequency and preference were measured using a five-point rating scale and six-point scale respectively. The rating scale was selected as for assessment based on the FAO guidelines for assessing nutrition-related Knowledge, Attitudes and Practices. The locally popular fruits and vegetables and those frequently advertised through media were listed down and respondent's use and preference for each item were rated separately. The rating scale was prepared, pre-tested and standardized before administering among the subjects. The percentage of total score for each food groups used by respondents as well as the preference score of the respondents for different food items were calculated separately using the following formula:

$$\text{Percentage of total score for each food items} = \frac{R_1S_1 + R_2S_2 + R_3S_3 + \ldots\ldots\ldots\ldots\ldots\ldots Rn\ Sn}{N}$$

S_1: Scale of rating given for frequency of use of a food item (i=1, 2, 3……6)

R_1: Percentage of respondents coming under each frequency group (i=1, 2, 3……6)
N: Maximum scale rating (n=6)

The mean score was calculated using the formula given below.

$$\text{Mean score for each food group} = \frac{R_1S_1 + R_2S_2 + R_3S_3 + \ldots\ldots\ldots\ldots\ldots\ldots Rn\ Sn}{100}$$

The percentage of respondents using each food item and also their preference for each item were then computed.

Tool 2: Actual Fruit and vegetable consumption One day Recall: The 24-hour recall was obtained from each subject during the first week of the study as a way to measure food consumption (behavior). This is a specific type of food diary that asks individuals to remember and record all of the food and beverages that they had consumed the previous day, where children record their food intake on worksheets. The 24-hour recall method was used to determine the quantity of fruit and vegetable in their diet consumed by subjects. From the data collected by the recall method the raw equivalent of the foods consumed was computed. For this, a set of cups and spoons were standardized by the investigator following the procedure given by Thimmayamma and Rao, 2003. The respondents were asked about the types of food preparations, they had for breakfast, lunch, teatime and dinner and the raw ingredients used for each of the preparations and the quantity consumed by them was then assessed using the standardized cups. The cups were used to aid the respondent to recall the quantities prepared and eaten. Later the raw food equivalents of the food consumed by the respondent were computed.
The frequency of use of fruits and vegetables: Based on the percentage frequency, fruits and included in the daily diet by the subjects the frequency was classified as most frequently (70-90 percentage score), medium frequently (60-70 percentage score), and less frequently (30-60 percentage score).

Tool 3: Participation score Sheet: A participation score sheet was prepared to note the attendance and participation in each activity by the subjects in the intervention programme.

Education Tools Prepared to Conduct the Nutrition Intervention: The following education tools were prepared to conduct the nutrition intervention. Multimedia tools: A flash movie and a power point Presentation: Three minutes movie in flash was prepared to motivate the children towards the consumption of fruits and vegetables. A PowerPoint presentation on the nutritional benefits of fruits and vegetables for children was also prepared. Education Games and Fun tools: Four games tools were developed for conducting nutrition intervention such as Fruit Shadows, Fruit Necklace, and Eat 5 A Day - Fruits & Vegetables, Fill a bowl with fresh fruits

Conduct of study

Pilot Study: A pilot study was undertaken to find out the reliability of the questionnaires, rating scale and checklist used and to see if it yields consistent results. The pilot study was undertaken to find out the applicability of the formulated tools immediately after formulating the tools for the present investigation. Ten students of 10 -12 years were subjected to pilot study. They were asked to fill the questionnaires on personal and socio-economic characteristics, food habits and preferences and actual fruit and vegetable consumption. The completed questionnaires were collected it back on the same day. The ten children were subjected to the tools once again the next day and collected on the same day. The scores of the two days were consolidated and were subjected to statistical analysis in order to find the reliability of the questionnaire. These were no significant difference between the two, hence the tools were considered to be reliable.

From the table 1 and 2, it is seen that there is no significant difference in the responses exhibited by the subjects in the two trials. Hence it reveals that this assessment tool is reliable.

Table 1: Actual fruit and vegetable consumption session

Category	Number	Mean value	Standard deviation
Vegetables 1st day	20	68.50	25.737
Vegetables 2nd day	20	68.50	25.737
Fruits 1st day	20	52.25	21.611
Fruits 2nd day	20	52.25	21.611

Table 2: Food use frequency of fruits and vegetables

Category	Number	Mean value	Standard deviation
Vegetables 1st day	20	3.29	0.849
Vegetables 2nd day	20	3.29	0.849
Fruits 1st day	20	3.54	0.638
Fruits 2nd day	20	3.54	0.638

Validity of the scales: The scale was constructed by keeping in view their face validity requirements. The term face validity is, by restricted to the fact that a test looks valid, particularly to those who are unsophisticated in test practices at the most elementary level, it is necessary for a questionnaire to have face validity that is each question must be related to the topic under investigation and the questions must be clear and unambiguous. An adequate validation required checking the response against an external criticism that questions on opinions, attitudes and evaluation should be checked by following the questionnaire with an interview of a sample of the respondents to the whether their responses to the questionnaire actually respect their views on the subject discussed. Hence the investigator followed the questionnaire with an in-depth interview of twenty respondents from the sample, for the sake of validation.

Main Study: The main study was done in three phases.
Phase I: Pre Intervention Assessments: The initial tests accompanied by biographical questionnaire to acquire details about the sample. The Personal and Socio-economic characteristics of the subjects were assessed using the questionnaire prepared. The Fruit and vegetable consumption pattern were determined using dietary recall method.

Phase 2: Nutrition Intervention
The nutrition intervention was conducted in different steps. At the onset the investigator developed a rapport with the subjects those who were selected for the nutrition intervention programme and the intervention was carried out in the following steps:

1. Breaking Ice and Motivation Session:

In order to motivate the children a flash movie of three minutes was presented. The participation of the subjects was evaluated based on their attendance to the session.

2. Nutrition Education using Multimedia approach:

The investigator presented a self-explaining power point presentation on the nutritional benefits of fruits and vegetables and its significance on the growth and development of the children. The participation of the subjects in this session was evaluated based on their attendance.

3. Raising a Nutrition Garden:

A self-explaining PowerPoint presentation; explaining how to start gardening in a school, was first shown to the children. The children were encouraged to raise a nutrition garden with the help of the teachers and a skilled labourer. The nutrition garden was raised at Government U.P.S Ambalathara in five cents rectangular land. The plants were raised in sacks and gunny bags. The plants like tomatoes, lady's finger, brinjal, amaranths, green chillies and peas were raised. The mixture was prepared using coir pits compost, cow dung, neem cake and red loam soil. The mixture was filled in the sacks. The nutrition garden was raised at the second centre at Government Model Higher Secondary School Venganoor. The participation of the subjects was recorded by the investigator using the participation score sheet.

Figure 1: Plants rose in gunny bags

4. Maintenance and Protection of the raised garden:

The subjects selected for the intervention programme were asked to regularly maintain and protect the garden every day for two months. The participation of the subjects in the activity was recorded by the class teacher using the participation score sheet.

Figure 2: Subjects maintaining and protecting the garden.

5. Harvesting:

The yield of the fruits and vegetables were reaped and was collected by the children as a team. The participation in these sessions was also recorded by the teachers.

6. Nutrition Games and Fun Session:

The children were introduced to nutrition games and fun sessions and their participation were noted by the investigator using the participation score sheet.

Phase 3: Impact evaluation of intervention: In order to evaluate the impact of the nutrition intervention, fruit and vegetable consumption pattern was assessed once again after the intervention. The same tools used for the pre-intervention assessment was used for the impact evaluation of the intervention.

Statistical Analysis: The data collected were scored, coded, consolidated and subjected to statistical analysis and interpretations. The statistical procedures used in the present study were: - mean, percentage, and $\chi 2$ test. The mean and percentage were carried out for finding out frequency distribution. Chi-square was used to find out the significance in fruit and vegetable consumption pattern with reference to biographical variables.

RESULTS AND DISCUSSION

In the present study, it was found the entire subject were non-vegetarians. A similar result was observed by Unnithan, 2008, Reshmi, 2007 and Krishnaroopa, 2003 in their studies undertaken in Thiruvananthapuram district where a majority of adolescents were noted as non – vegetarians. Consumption pattern of keralities as reported by Kerala Statistical Institute, 2008 also revealed that 98% of keralities are habituated to non- vegetarian foods.

Actual fruit and vegetable consumption pattern of the subjects

On assessing the frequency of use of various fruit and vegetables, as depicted in table 3, it was observed that the green leafy vegetables were consumed occasionally. Some kind of roots and tubers like beetroot, carrot, onion, potato, sweet potato, tapioca, and yam and other vegetables like ash guard, cucumber, drumstick, plantain, pumpkin was consumed weekly ones. Similar results done by Mony (1993) reveal that the roots and tubers were consumed less frequently by adolescents.

Table 3: Food Frequency uses of fruits and vegetables

Food items	Daily	Weekly	Fortnightly	Monthly	Occasionally	Never
Green leafy vegetables						
Amaranths	4	42	7	4	38	5
Agathi	1	4	5	9	23	58
Curry leaves	74	9	2	1	7	7
Cabbage	27	29	5	11	22	6
Drumstick leaves	4	23	15	11	32	15
Root and Tubes						
Beetroot	22	38	13	3	14	10
Carrot	42	27	10	5	15	1
Colocacia	5	27	12	13	29	14
Onion	27	39	13	8	11	2
Potato	26	35	15	4	18	2
Sweet potato	11	12	11	10	43	13
Tapioca	37	29	10	7	17	-
Yam	23	35	11	8	16	7
Other vegetables						
Ash gourd	3	5	14	14	23	41
Beans	20	28	8	13	18	13
Bitter gourd	7	12	5	9	31	36
Brinjal	17	26	19	12	15	11
Cauliflower	3	15	11	8	29	34

Food items	Daily	Weekly	Fortnightly	Monthly	Occasionally	Never
Cucumber	45	23	11	6	13	2
Drumstick	27	31	8	10	10	14
Lady's finger	35	30	4	5	16	10
Plantain	22	9	10	8	23	28
Pumpkin	13	8	15	13	37	14
Raw mango	23	18	15	17	21	6
Snake gourd	14	17	9	14	32	14
Tomato	18	28	20	12	17	5
Fruits						
Amla	27	22	9	13	26	3
Apple	13	23	13	17	31	3
Banana	51	27	3	4	13	2
Grapes	23	18	16	16	26	1
Guava	12	26	22	14	25	1
Jackfruit	7	14	17	20	38	4
Mango	14	37	20	18	11	-
Orange	12	11	13	13	31	20
Papaya	23	20	16	12	27	2
Pineapple	11	26	19	20	22	2
Seethaphal	2	11	15	20	40	12
Watermelon	13	35	16	19	14	3

Table 4 portrays the consumption pattern of fruits and vegetables by subjects before and after the intervention programme. It was understood by the investigator that bitter gourd was not preferred due to its bitter taste. Similarly, the taste of ash gourd was also not preferred by the subjects. The non-availability of agathi, seethaphal and cauliflower in the local market was the reason for being less consumed.

Table 4: Consumption of fruits and vegetables by subjects based on percentage frequency, before and after the intervention programme

Particulars	Before intervention programme	After intervention programme
Most frequently used food	Curry leaves, Carrot, Beetroot, Onion, Potato, Tapioca, Yam, Banana, Mango	Beet root, Cabbage, Carrot, Cucumber, Curry leaves, Drumstick, Lady's finger, Onion, Potato, Tapioca, Tomato, Yam, Amla, Banana, Mango, Guava
Medium frequently used food	Cabbage, Beans, Drumstick, Raw mango, Tomato, Brinjal, Apple, Amla, Grapes, Guava, Papaya, Pineapple, Watermelon	Amaranth, Beans, Brinjal, Colocacia, Drumstick leaves, Plantain, Pumpkin, Raw mango, Snake gourd, Sweet potato, Apple, Grapes, Jack fruit, Orange, Papaya, Pineapple, Water melon
Less frequently used food	Amaranth, Drumstick, Agathi, Colocacia, Ash gourd, Bitter gourd, Cauliflower, Plantain, Pumpkin, Snake gourd, Sweet potato, Jackfruit, Orange, Seethaphal	Agathi, Ash gourd, Bitter gourd, Cauliflower, Seethaphal

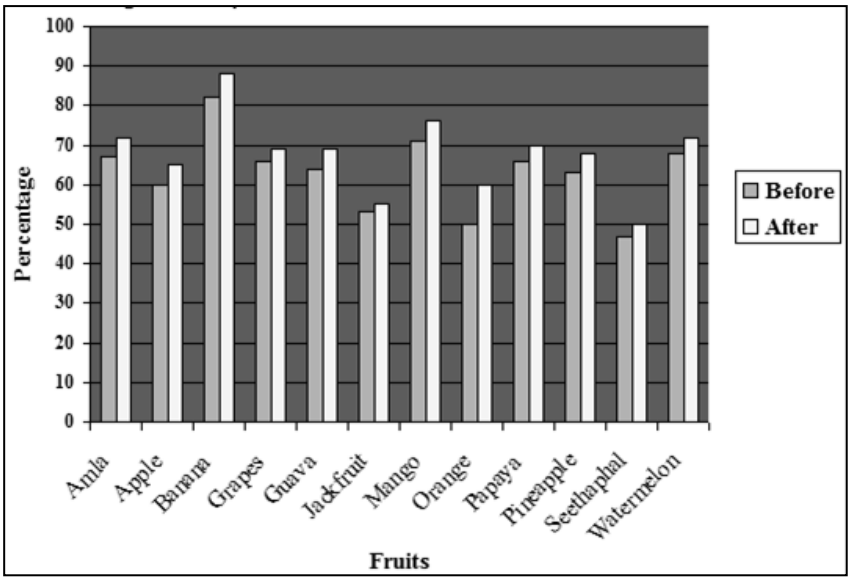

Figure 3: Consumption of Fruits, before and after the intervention

The figure 3 very clearly depicts that the percentage of consumption has increased after the garden-based nutrition intervention especially with reference to the intake of amla, apple, banana, grapes, guava, jackfruit, mango, orange, papaya, pineapple, seethaphal and watermelon.

Table 5 depicts the mean intake pre-intervention of fruits was 60 g per day while vegetable intake was 66.2 g per day. The consumption rate is below the recommended level and similar results were also seen in the study of Krishnaroopa (2003) which reveals that fruits and vegetables are less consumed by the children when compared to other food items especially meat and poultry products in their studies done at Thiruvananthapuram. After the nutrition intervention programme, the mean intake has increased and it revealed that intake of fruits was 80 (g) per day while vegetable intake was 88.5 (g) per day

Table 5: Change in mean intakes of fruits and vegetables per day

Mean intake of fruits		Mean intake of vegetables	
Pre intervention	Post intervention	Pre intervention	Post intervention
60	80	66.2	85

The results of the analysis of the data shown in table 6 revealed that the food consumption score for vegetables, fruits and vegetables + fruits when studied with reference to family type, more changes were seen among the joint families. When the family size of the subjects, was studied it was seen that fruit and vegetable consumption changes were seen among the large size of families. The vegetable consumption is 28.13, fruit consumption change is 42.50 and the vegetable + fruit consumption change is 70.63.

Table 6, revealed that with respect to food consumption, the vegetable consumption among the different income groups and vegetable + fruit consumption change was seen more among the upper-middle-income families and fruit consumption change was found to be more among low income families. The fruit consumption changes found in the low-income group is because the other groups were already aware of the importance of incorporating fruits and vegetables in the diet. Many of the changes in food consumption patterns discussed above are reflective of the nutrition transition—a series of changes in diet, physical activity and health among the middle and upper middle groups in Kerala that was revealed in studies conducted by Unnithan (2008). The present nutrition intervention among the students has created awareness among the low-income families hence the changes in the consumption pattern.

Table 6: Fruit and Vegetable consumption pattern with reference to Biographical Variables

Mean				
		Food consumption level		
Variables	**Number**	**Vegetables**	**Fruits**	**Vegetable + fruit**
Religion				
Hindu	50	20.90	38.30	59.20
Christian	16	28.75	46.88	75.63
Muslim	34	21.32	28.68	50.00
F value		**0.93**	**1.94**	**2.95**
Family type				
Nuclear	74	20.88	33.85	54.73
Joint	12	27.50	44.17	71.67
Extended	14	25.36	43.21	68.57
F value		**0.70**	**0.89**	**1.83**
Family size				
Small	51	23.73	30.78	54.51
Medium	41	19.39	42.20	61.59
Large	8	28.13	42.50	70.63
F value		**0.84**	**1.59**	**0.94**
Educational status				
Father				
Lower primary	4	16.00	36.00	52.00
Upper primary	19	12.11	36.58	48.68
High school	68	26.54	34.71	61.25
College	7	16.43	57.86	74.29
F value		**2.57***	**1.15**	**1.56**
Mother				
Lower primary	3	23.33	45.00	68.33
Upper primary	18	22.22	35.00	57.22
High school	60	21.50	34.83	56.33
College	19	24.74	41.32	66.05
F value		**0.12**	**0.27**	**0.44**
Family income (Rs.)				
2500-3500	31	19.19	47.58	66.77
3501-4500	34	20.15	29.41	49.56
4501-6000	10	25.00	26.50	51.50
6001-8500	7	45.71	27.14	72.86
>8501	18	21.11	39.44	60.56
F value		**2.75***	**1.80**	**1.37**

CONCLUSION

The overarching goal of this study was to promote the fruit and vegetable consumption among school children through garden-based nutrition intervention programme. Recent literature shows that the consumption of fruit and vegetables among school children in Kerala are inadequate and the trend of junk food eating habit is increasing alarmingly. A wealth of anecdotal evidence reveals that gardening with nutrition education programmes effects multiple domains in the lives of the subjects'. Several studies have revealed that garden-based nutrition intervention has increased nutrition knowledge. (Jones, 2008) Some research studies have found that there is an increase in fruit and vegetable consumption as well as an increase in healthy snack consumption (Mc Aleese &Rankin, 2007). Furthermore studies have shown that a nutrition lesson combined with gardening increases children's preference for vegetables and has better long term effects on the student vegetable preference (Morris et al., 2002; Lineberger and Zajicek 2000; Genzer et al., 2001; Nolan, 2006). Morris et al (2002) also reported that nutrition lessons combined with gardening improved nutritional knowledge and vegetable reference of fourth-grade students. This study supports after the use of garden-based nutrition intervention programme as an effective tool for increasing the consumption of fruit and the vegetable intake per day. The intervention programme had a significant effect on the gain in knowledge as well as a change in preference score for fruits and vegetables.

RECOMMENDATION

The results of the study show that garden-based nutrition intervention can improve the consumption and preference of fruits and vegetables among the school going students, hence it is recommended that every school introduces garden activity in the school along with nutrition education.

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TRENDS IN THE USE OF NUTRITION MESSAGES ON FOOD LABELS BY GRADUATE CONSUMERS IN MUMBAI CITY

Manisha Parelkar*

Access and attention to the nutrition messages on food labels is an important step for the use of this information, by consumers in making health-promoting decisions. The present study was an attempt to ascertain the same in the City of Mumbai. The objective of this study was to explore the trends in the use of nutrition messages on food labels by consumers on Ready-to-eat (RTE) pre-packaged foods. A total of 919 graduate consumers between the ages of 21-60 years, participated in the study, by responding to the pre-validated tool. 51.5% consumers reported that they purchased of RTE foods from grocery shops. Brand (32.1%) and taste (31.6%) were major determinants of their choice over nutrition messages. Front Of Pack (FOP) messages were accessed more than the Back Of Pack (BOP) nutrition messages. The major motive for accessing information was for fitness rather than disease prevention or control. The key nutrients on the nutrition information panel referred to were fat (46.2%) and cholesterol (44.3%). The major factors deterring reading of nutrition labels were small font size (49.7%) and time constraints (47.9%). Understanding these trends in the use of nutrition messages may aid in improving health communication with consumers by health professionals to combat the high incidence of diet-related non-communicable diseases (DR-NCDs) especially in the urban cities of India.

Keywords: Consumers, Food Labels, Nutrition Messages

INTRODUCTION

In the Indian culture, eating is celebrated and enjoyed. Food from a consumer's point of view is about freedom in food choices. This may result in inappropriate food choices. Food labels are considered a crucial component of strategies tackling unhealthy diets leading to obesity. The food, nutrition, diet and non-communicable diseases (NCDs) are intrinsically linked. Hence when NCDs are to be addressed, the food and diets along with the nutritional status are critical determinants of diet-related NCDs. There are global trends pointing towards increased caloric intake through oils, fats, sugars, and meat along with a lowered contribution from whole-grains, pulses and other naturally fiber-rich foods. (Euromonitor, 2009) The changing lifestyles, increased affordability and easy availability and consumption of processed and convenience foods have spiked up in a few decades and continue to do so in the LMICs (Low, middle-income countries) like India. (Popkins et al 2012, 2013) This nutrition transition over the past few decades has left us dealing with epidemic proportions of Diet-related Non-communicable diseases (DR-NCDs). Food Labelling Regulations by FSSAI are a part of India's public health strategy to combat the same. (FSSAI, 2011) The ultimate intent is for consumers to use these for choosing foods to meet their health goals. In these times of abundance of food, consumers seem to be eager to be fit and healthy. It is still unclear as of now if the consumers can access and use the nutrition messages on food labels at the point of purchase.

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The dilemma being, are consumers able to go beyond the catchy, tempting pictures and text cluttering food labels over actual nutrition messages?

The research attempts to analyze the trends in use of nutrition messages on food labels by studying their self-reported behavior while purchasing Ready-To-Eat (RTE) Foods. The findings may enable the health professionals and the Policy-makers to develop improved modes of risk communication to consumers through consumer-friendly food label formats. Nudging the consumers to base their choices on science-based facts and filter out hyped, half-baked ideas and food myths may simplify their healthy food buying experience and reach informed decisions skillfully. This can provide a platform for governments to reduce health service costs since a healthy population is a key to the long-term economic development of individuals as well as the country.

MATERIALS AND METHODS

A cross-sectional study was conducted on Consumers in the Metro City of Mumbai. Ethics approval was granted by ISBEC, Mumbai (vide ISBEC/NR-18/KM-JVJ/2014).

The consumer survey was arranged by obtaining the necessary permissions from the concerned authorities at various workplaces, housing societies and Education Institutes' in the City. The participants were recruited by snowballing technique through the key-person in each set-up.

A sample size of 900 consumers was calculated on the assumption that 35% of Consumers purchasing pre-packaged RTE foods used nutrition labels, along with 95% Confidence interval and a relative precision of 20%. The inclusion criteria of participants were that they were adults between 21-60 years of age, with Graduation as their minimum qualification, were purchasers of RTE foods. The exclusion criterion was that they were graduates in Nutrition

A validated and pre-tested questionnaire was used to derive responses from consumers. Statistical analysis was conducted using the SPSS Package Version-17.

RESULTS AND DISCUSSION

The trends in consumer behavior regarding the place of purchase, their motives and their focus on nutrients and nutrition messages on food labels are elaborated below.

Purchase Setting

Figure 1 depicts that of the many factors, which may influence the optimal use of food labels is the place of purchase. Supermarkets and retail stores with food products displayed in aisles may provide better access to nutrition messages than the conventional grocery stores where the shop-keeper hands over the products.

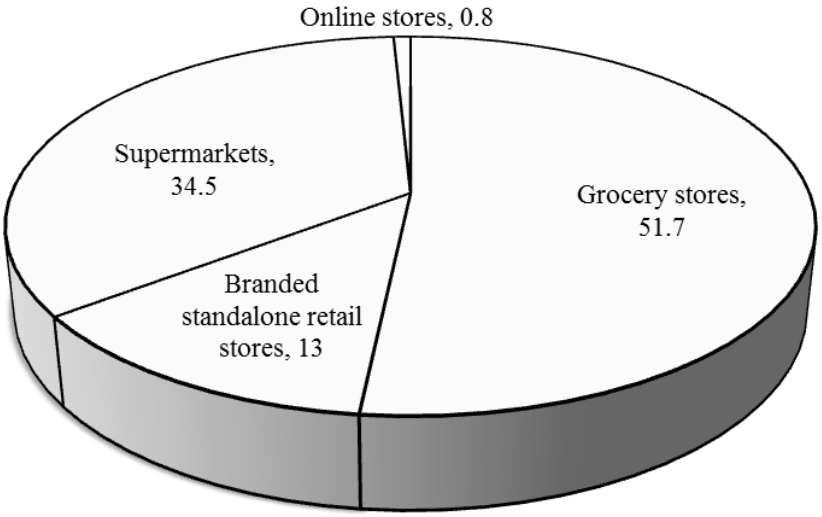

Figure 1: Place of Most Frequent Purchase (%) of RTE Foods

More than half the consumers (51.5%) reported that they purchased of RTE foods from grocery shops suggesting that most consumers in Mumbai may have a limited access to nutrition messages on food labels. The other purchase locations opted by the consumers except online shopping may provide a physical environment and a multitude of food products of varying food categories conducive to evaluate the health value of products at the point of purchase.

Product Attributes Capturing Consumer Attention

Product attributes are characteristics that characterize a particular product and influence consumer purchase behavior. Some of them are tangible like the brand, claims, images, and colours on food labels and sensory characteristics, like the taste, mouth-feel, and flavours of the product. Some others are intangible like the nutrient content of food products.

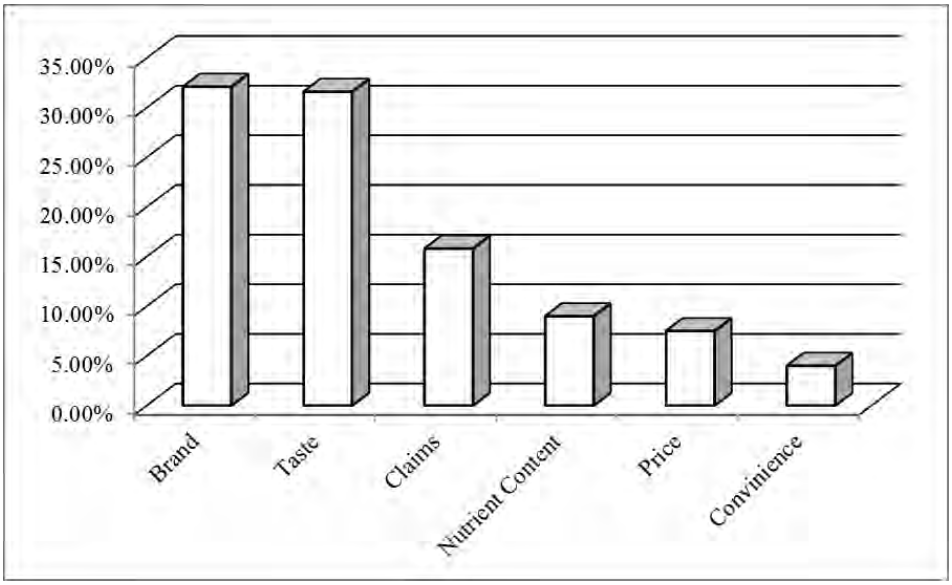

Figure 2: Product Attributes Valued during the Purchase for RTE foods

Figure 2 represents the product attributes valued during the purchase for RTE foods. The trends reveal that brand (32.1%) & claims (31.6%), which are search attributes and taste (16%), which is an experience attribute, majorly influence consumer choices. Whereas the nutrient content being credence attribute, which grossly underrated during their purchase decisions. Similar findings have been reported in other studies. (S.R Vemula et al 2013) There is a possibility of clever marketing of food products distracting consumers in their purchase decisions. This may lead the consumers in buying products which actually may not be as nutritious as they look due to the appealing attention hooks such as brand name, colours, images and claims on the FOP.

Nutrition Messages accessed for when choosing healthy options

Food labels have the potential to contribute to the achievement of public health objectives more through Front of Pack (FOP) messages and Back of Pack (BOP) messages in countries where FOP systems are used, they are like nutrient profiling. (Sacks, 2011) But since India does not currently support any FOP system by any regulation, BOP nutrition messages about the nutritional content and health benefits of food is particularly important. Two types of such information appearing on food products are the "nutrition labels" listing nutrients and the ingredient list, through which the amounts of specific ingredients are listed, can be perceived as a public health measure because it helps consumers to assess a number of healthy ingredients present in foods. The FOP mainly focuses on health claims & nutrient claims (statements connecting a food, food component or a nutrient to a state of desired health) provide information to consumers about the nutritional and health advantages of particular foods or nutrients. If appropriately applied, they may help consumers to choose foods associated with good nutrition and health. Health claims are also a valuable marketing technique for food companies since they are far more visible on food packages than nutrition labels and a point of

differentiation between one product and another. Hence discerning consumers need to focus on BOP messages, which are more detailed and represent science-based objective nutrition messages than the FOP messages, which may work on attracting consumers to choose the products on an emotional basis.

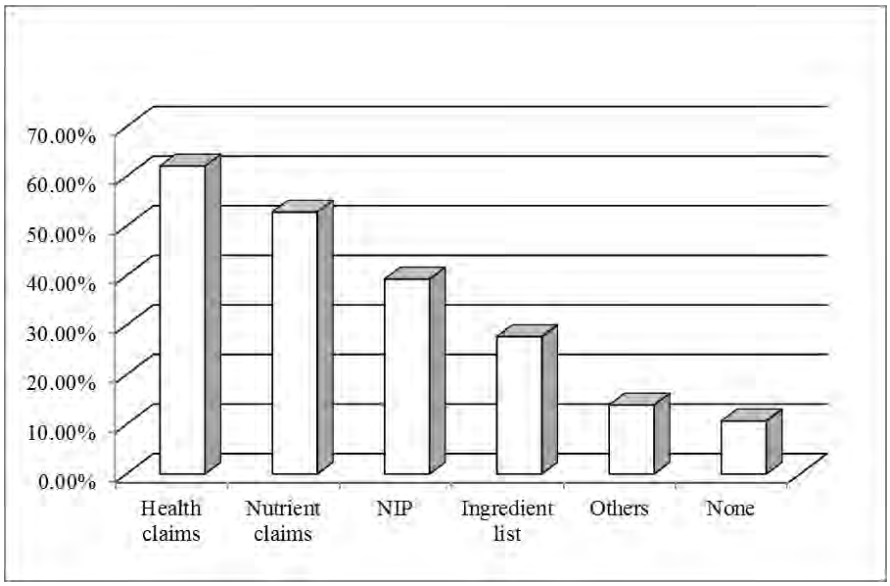

Figure 3: Nutrition Messages Accessed While Choosing "Healthy Options"

Figure 3 reveals that Front Of Pack (FOP) messages in the form of health claims (62.10%) & nutrient claims (52.80%) were accessed more frequently as compared to the Back Of Pack (BOP) nutrition messages. 39.30% of the respondents reported to accessing the Nutrition Information Panel, whereas only 27.70% accessed the Ingredient list while choosing Ready-To-Eat Foods. Consumers may need to be educated in the use of BOP nutrition messages. This may assist them to base their food choices on objective and science-based facts, which are under the purview of the regulatory authorities than only on the FOP messages.

Motives for Accessing Nutrition Information Panel (NIP)

The Health authorities intend that the NIP is used mainly for preventive and curative purposes with regard to DR-NCDs. The consumer perspective on the same should be considered, as they are the end-users of NIP. This can help us truly gauge whether the vision of the health authorities is in sync with the consumers.

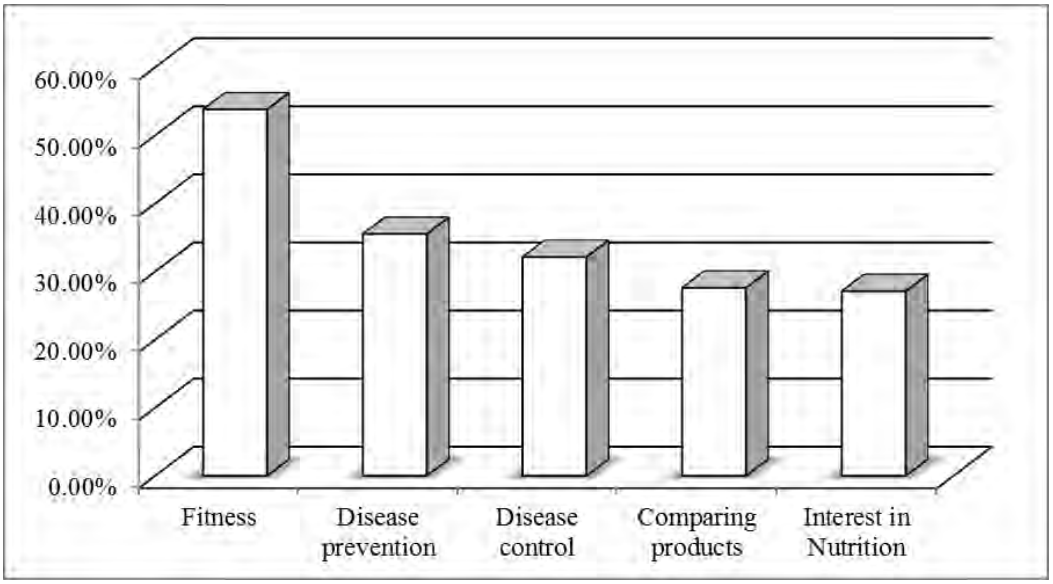

Figure 4: Motives for Accessing the Nutrition Information Panel (NIP)

Figure 4 portrays that the major motives for accessing information reported by consumers were higher for fitness (53.80%) rather than disease prevention (35.50%) or control (32.10%). But improved health communication, about the use of NIP for also for disease prevention and disease control with a specific focus on DR-NCDs, could go a long way in combating the epidemic of these diseases that India is currently facing.

The Nutrients Accessed

These may help us understand the nutrients that consumers identify as the relevant ones to be managed to achieve their health concerns or goals.

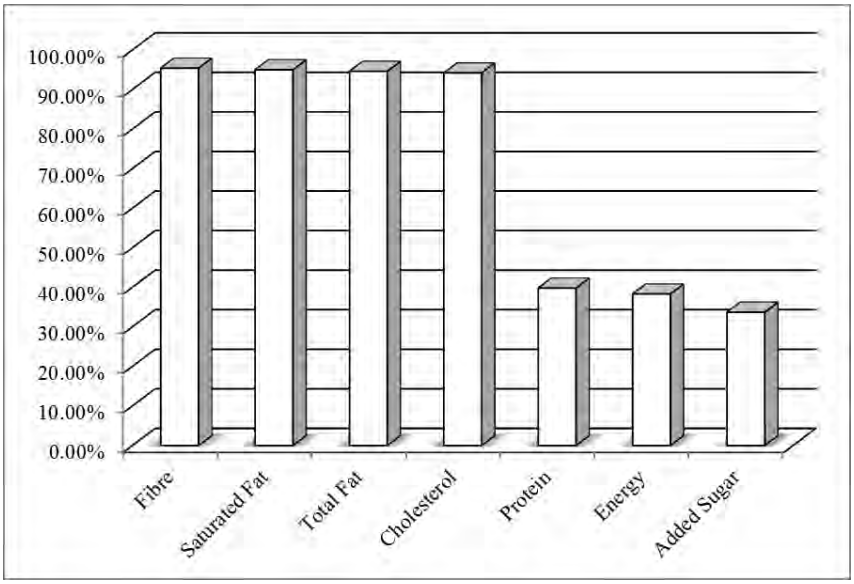

Figure 5: Key Nutrients accessed

Figure 5 represents the key nutrients on the nutrition information panel referred by consumers. Over 90% of the respondents were fiber (95.40%), fat (94.60%), saturated fat (95.00%) and cholesterol (94.20%). Similar findings with respect to fat have been reported by Vemula et al 2013. Except for the fiber and cholesterol content of foods, the rest of the nutrients accessed are the ones which WHO has notified as nutrients of concern to address the alarming incidence of Diet-related non-communicable diseases. The ones of lesser interest to consumers have added sugars (33.70%). The nutrients recommended by experts to be increased are fiber and proteins. Consumers report to be concerned about the fiber and protein content (39.80%) of foods is heartening. Also, the lower priority given to the energy content (38.3%) as compared to other macronutrients like fats & protein is also an encouraging trend. Consumers may not be aware of the implications of high sodium in diets and therefore it does not figure as a high priority nutrient to be accessed. Also, sodium content labeling is not mandatory in FSSA 2011 unless a claim is made with regard to the same; hence many manufacturers do not print them on food labeling. (FSSAI, 2017)

Factors influencing the use of NIPs

The WHO intends that consumer's access and use the NIP to make wise food choices to enable them to lead healthy lives, free from the burden of diseases. (WHO, 2013) For this intent to be fruitful, consumers must be encouraged to access the NIP. Many studies have revealed that several factors discourage them to do the same. (Ali, 2009; Singla, 2010; Vemula et al, 2014)

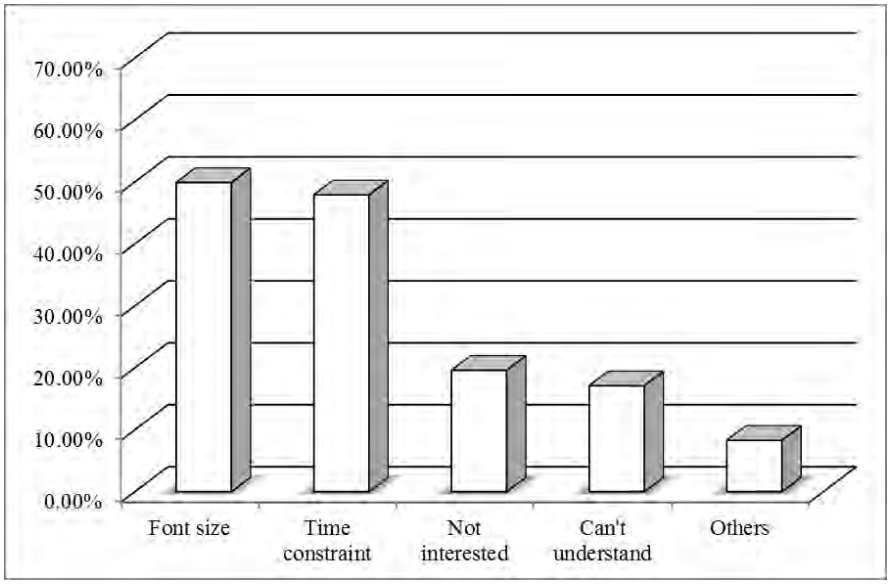

Figure 6: Factors discouraging the use of Nutrition labels

The various factors which discourage consumers' use of nutrition labels are illustrated in Figure 6. Respondents in this study too reported that the two major factors deterring their use of nutrition labels were small font size (49.90%) and time constraints (47.90%).

The findings support the findings of the study conducted in two metro cities – Hyderabad and Delhi (S.R Vemula et al 2013). Hence it is imperative to redesign the NIP and also add on FOP nutrition messages to overcome the limitations of the current labeling system. This may provide the thrust envisaged by the health authorities for encouraging consumers to use nutrition messages on food labels to achieve their health goals.

CONCLUSION

The extent to which nutrition messages on food labels influence the overall consumer health remains to be determined. Nevertheless, understanding the gaps in their access and attention, by studying the trends as attempted by this study may aid in improving health communication with consumers. The findings of this study provide a fair sense of how the consumer uses food labels. Consumers need to overcome visual distractors and focus attention on reliable, science-based nutrition messages and use them to while choosing foods to meet their health goals.But a lot of in-depth efforts are further needed to understand the consumer opinion on the relevance and comprehension of the current food labeling systems. This can go a long way in the development of consumer-friendly food labels. This, in turn, may help achieve its optimum utilization to aid food choices. Only then the purpose of nutrition messages on food labels may be used optimally as a public health strategy to combat the DR-NCD epidemic.

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