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Development and analysis of multi-nut spread for children aged between 7-9 years

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Abstract
Nuts are super foods which are a good source of energy, protein, omega fatty acids, calcium and phosphorus which are crucial for the normal growth and development of growing children. Children from high income groups are also suffering from malnourishment due to poor food habits and picky eating. A market survey was carried out to identify the ready to eat sweet spreads available in the market, which revealed that the available products were high in sugars and fats; therefore a nutritious multi-nut spread was developed using peanuts, walnuts, sesame seeds and flax seeds. Sensory evaluation of the products developed was performed using 9-point Hedonic Scale. The most acceptable product was analysed for physical and chemical parameters like moisture, ash, protein, fat, carbohydrate, calcium, phosphorous, tannin, omega fat ratio. The results showed that the developed multi nut spread provided the optimum nutrients required by children as compared to those available in the market.

Keywords: calcium, flaxseeds, multi nut spread, omega 6 and omega 3 fatty acid ratio, sesame seeds

1. Introduction

Malnutrition commonly affects all groups in a community, but infants and young children are the most vulnerable because of their high nutritional requirements for growth and development. Undernourishment may not always be due to poor economical status. Lack of knowledge and resources are one of the leading factors causing undernourishment to persist in middle and high income groups as well.

Children are generally restless and do not like spending time on eating. Menus should provide dishes that are quick to eat and satisfying. Moreover children have varying appetites and they prefer light snacks rather than a heavy meal [20]. Most of the children have a liking for sweeter food items, therefore sweet spreads like jams, marmalades and cocoa spreads which are unhealthy because of their high content of carbohydrates (mainly sugars) and fats and low content of proteins and micronutrients. Products like peanut butter are available in the market, which come under the category of sweet spreads, but people are not aware of the health benefits it has compared to other sweet spreads [15]. Peanut spread contains more proteins and healthy unsaturated fatty acids compared to the other ready to eat sweet snacks [5]. School children excessively consume food rich in fat and sugar, consume less of fruits and vegetables and skip breakfast often. Stress appears to be consistently harmful to children in terms of steering their food choices away from the healthy towards the unhealthy. With the right guidance and nutrition education children can learn to prefer healthy foods. Psychological factors which contribute to depression or poor motivation to eat should be identified. The child's likes and dislikes needs to be considered while feeding otherwise the child might abstain from eating at all [21].

Nuts and seeds are the storehouse of health benefiting poly-phenolic flavonoid, antioxidants such as carotenes, resveratrol, lutein, cryptoxanthin, etc. These compounds have been found to offer protection against cancers, heart disease, degenerative nerve disease, Attention Deficit Hyperactivity Disorder (ADHD), and viral/fungal infections [4, 17]. Like pulses, oil seeds and nuts are rich in protein and in addition they contain a high level of fat. Hence they are not only good sources of protein but are a concentrated source of energy and can provide children adequate nutrients which would assist them in their growth and development. They do not contain an appreciable amount of carbohydrate but contains a high level of B-vitamins. They are a rich source of all the important omega-3 essential fatty acids like linoleic acid, a-linolenic acid (ALA), eicosapentaenoic acid and docosahexaenoic acid [10].

The main objective of the present study was to develop a substitute for sweet spreads appreciated by children (7-9 years) by incorporating the benefits of nuts and oilseeds and hence prepare a multi nut spread which is not only convenient but also provides a supply of essential nutrients.

2. Methods and Material

2.1 Market survey

A market survey was carried out in various retail shops like Spencer's Retail, Big Bazaar and local grocery shops of Kolkata to find out the types of sweet spreads available, their nutritional content and to note down the popular flavours and variations available in the market.

2.2 Procurement of raw materials

Raw materials like peanuts, sunflower seeds, walnuts,

flaxseeds, oil and honey were procured from the local market of Kolkata.

2.3 Development of the product

Multi-nut spread was developed using different nuts and oilseeds. (Table 1) The nuts and oilseeds were first soaked in water for 8 hours (except flax seeds). They were then dried using oven drying at 70ºC for 6-8 hours followed by cooling to room temperature. The ingredients were then pulverized in a food processor and mixed with honey as a sweetener. A resting time of 30 minutes was then provided to the mixture and stored in a food grade plastic container.

Table 1: Basic Recipe of the multi nut spread (Product S)

Ingredients	Amount
Peanuts	50 g
Sunflower seeds	30 g
Walnuts	20 g
Oil	5 ml
Honey	10 g

Based on the basic recipe a number of variations were subsequently developed to increase the nutritive value using a combination of nuts and oilseeds. (Table 2) After the sensory evaluation was done, the most acceptable product was selected, and flavour variations were made with it. The two flavours prepared were, Chocolate Delight and Caramel Crunch.

Table 2: Different variations of multi nut spread

Ingredients	Variations			
	Product A	Product B	Product C	Product D
Peanuts	50 g	50 g	50 g	50 g
Sesame Seeds	30 g	30 g	30 g	30 g
Walnuts	15 g	10 g	5 g	0 g
Flaxseeds	5 g	10 g	15 g	20 g
Oil	5 ml	5 ml	5 ml	5 ml
Honey	10 ml	10 ml	10 ml	10 l

2.4 Sensory Evaluation

The sensory evaluation of the standard recipe and the variations was done by 20 panel members comprising of post graduate students from the Department of Food Science and Nutrition Management of J. D. Birla Institute using 9 point Hedonic Scale and Just About Right Scale [15].

2.5 Chemical Analysis

The chemical parameters like moisture content, total ash, protein, fat, total carbohydrate, calcium, phosphorus and tannin content were estimated. Chemical analysis was done for the basic product and the most approved variation.

The protein content was measured using the Kjeldahl method [18]. The fat and the carbohydrate content of the two products were measured using the Rose-Gottlieb method [13] and the Anthrone method respectively [14]. The two products was converted to ash in a muffle furnace for micronutrient estimation. The calcium content was measured by the End OCPC method while the phosphorous content was measured using the molybdate U.V. method [19]. Tannins were estimated by Folin-Denis method [20]. The shelf life of the two products was tested by placing the products in food grade plastic containers and placing each of the two at room temperature and at a refrigeration temperature. The cost calculations were done for each variation of the multi-nut spread.

2.6 Statistical Analysis

The data was analyzed using standard deviation and unpaired student's t-Score and the P-scores of the sensory evaluation scores were calculated using an online statistical calculator.

3. Results and Discussion

3.1 Results of Sensory Evaluation

The acceptability of the basic recipe and the variations was done using 9 point hedonic scale and a comparative study between the variations was done. The results reveal (Table 3) that Product C is the most acceptable variation.

Table 3: Sensory Evaluation of the basic recipe and different variations

Product Code	Appearance	Colour	Taste	Texture	Odour	Overall Rating
Product S	7.9 ±0.44	8.35±0.45	6.5±0.51	8.6±0.48	7.5±0.51	8.0±0.92
Product A	7.8±0.41	8.05±0.22	7.2±0.41	7.4±0.51	7.6±0.81	7.3±0.49
Product B	7.6±0.50	7.75±0.44	7.8±0.42	7.9±0.83	7.6±0.51	7.2±0.43
Product C	7.25±0.44	7.5±0.51	8.25±0.55	8.1±0.87	7.3±0.67	7.6±0.48
Product D	5.9±0.45	6.75±0.44	6.8±0.69	7.7±0.62	5.2±0.90	5.4±0.90

It can be seen (Table 3) that incorporation of flax seeds had reduced the appearance of the spread considerably as compared to the basic recipe due to secoisolariciresinol diglucoside, the compound which is responsible for brown

color of the flax seeds which imparts a darker hue to the products [26]. The incorporation of sesame seeds did not affect the appearance much since the colour of sesame seeds is off-white. Product D received the lowest score in colour due to a high content of flax seeds. The scores of the products show that the panel members preferred lighter colour.

The standard recipe which is Product S, contained sunflower seeds which imparted a metallic aftertaste, therefore the taste was not appreciated by the panel members. The variations contained flax seeds, which also leaves a pungent after taste but it was counteracted by the taste of the sesame seeds. The taste of the variations was received better by the panel members as compared to the standard product and the Product C scored the highest in the taste attribute.

Due to the hydro colloidal properties of the flax seeds, the spread became stickier in nature [26]. Product C received the highest score in texture among all the variations. Product D was reported to be too sticky, whereas Product A and B, did not have the desirable sticky consistency.

There was a slight nutty aroma in the products, due to roasting of the nuts. It was a desirable characteristic. Product A and Product B scored better than the Product S, since sesame seeds were added to the variations and it gave a better aroma to the product.

The overall rating of the variations reduced as compared to the standard product. It was mainly due to the colour and odour changes which had occurred after the addition of flax seeds. Product C received the most appreciation as compared to the other variations and was the most acceptable variation. It had high scoring of taste, texture as well as odour. Peanuts and sesame seeds synergistically masked the pungent odour of flaxseeds very well. The main aroma components in sesame seeds are due to sesamin and sesamolin [11].

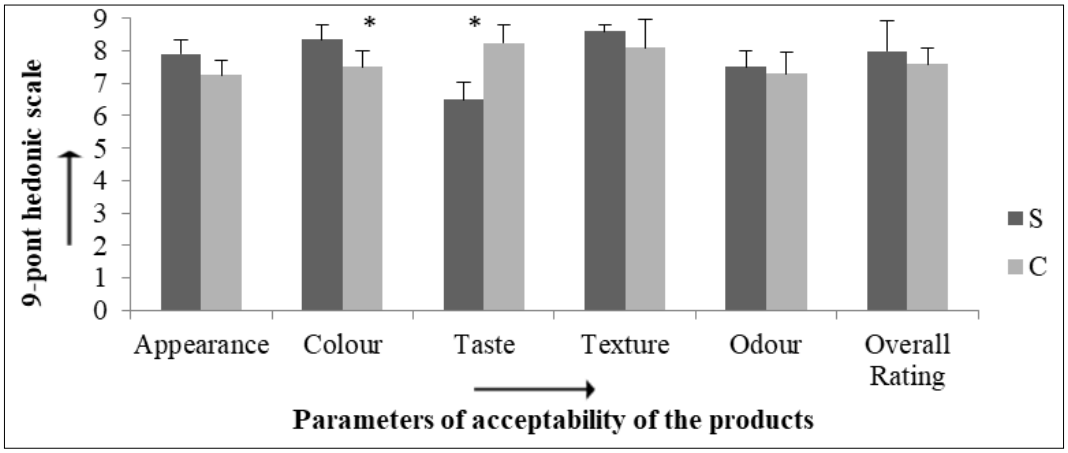

Fig 1: Comparison of Sensory evaluation of the Product S and Product C. (*) P-score <0.05 represents statistically significant results. The p-score of the attributes were calculated by student's t-score which revealed that incorporation of flaxseeds and sesame seeds caused statistically significant differences in attributes like appearance, colour and taste, and not statistically significant differences in attributes like texture, odour and overall rating.

3.2 Results of Just About Right Scale [15]

The most appreciated variation, Product C was compared to two commercial nut spreads from popular brands available in Kolkata. The products were tested on the attributes like spreadability, overall flavour and aroma and texture. The test was done using the JAR [Just about right] scale [44]. Products C when compared to commercial product 1 and commercial product 2 received acceptable scores in the attributes of spreadability, over-all flavour, aroma and texture. It received a score of 5.65 in spreadability, 6.3 in overall flavour and 4.15 in aroma. All the scores of the sensory attributes were close to 5, which is the optimum score in JAR Scale.

As Product C was the most acceptable, two flavours of the approved variations were made. The attributes of the developed flavours were tested by using the 9-point hedonic scale. Product C_1 (Chocolate Delight) was preferred in terms of all attributes except odour as compared to the Product C and Product C_2 (Caramel Crunch). The best score for odour was of Product C_2 (8.85). Both the developed flavours were appreciated more than the plain Product C, but chocolate was found to be more popular since it one of the most appreciated flavours in sweet products universally.

3.3 Chemical Analysis

A comparative study of the various chemical parameters of the basic and the most acceptable recipe was done.

Table 4: Chemical Analysis of the Basic and most acceptable variation

Parameters	Basic Recipe (Product S)	Product C
Moisture (%)	0.12	0.09
Ash (%)	16	19
Protein (g/100g)	14.45	14.25
Carbohydrate (g/100g)	14.6	12.3
Fat (g/100g)	48g	42g
Calcium (mg/100g)	78.89	589.4
Phosphorous(mg/100g)	180	170
Tannin (mg/100g)	4.6	7.8

The values of the moisture content are extremely low since no water added to the product and the ingredients which had been soaked earlier were oven-dried. Honey which is used as a sweetener had some moisture. Incorporation of both flax seed and sesame seeds increased the ash content in product. The fat content reduced by 6g in Product C due to the incorporation of

flax seeds with the husk. Product S provides 548.2 kcal per 100g of the product, whereas Product C provides 484.2 kcal per 100g of the product. The husk of the flax seeds contributed to the high fibre content, reducing the fat, carbohydrate and energy content.

Incorporation of sesame seeds in the variations increased the calcium content drastically when compared to the standard recipe. The tannin content of Product C is higher due to the high flax seed content.

Nuts are a rich in Omega-3 and Omega-6 fatty acids. The balance between these two fatty acids is very crucial in normal growth and development for children. The ratio between omega-6 and omega-3 should be 2:1 to 4:1, a ratio different than this causes imbalance in the metabolism and affects the normal functioning of the fatty acids. The omega 3 fatty acid content of Product S is 1.81g/100g of product and of Product C is 4.12g/100g of product. The omega 6 fatty acid content of Product S is 21.95g/100g of product and of Product is 17.33g/100g of product. Therefore the ratio of omega 6 and omega 3 fatty acids in Product S is 21:1 and 4.25:1 in Product C. The ratio of omega 6 and omega 3 fatty acids in Product C is closer to the correct ratio which is 2-4:1 [7, 11].

3.4 Shelf Life

The shelf life of the two products was tested by placing the products in food grade plastic containers and placing each of the two at room temperature and at a refrigeration temperature. It was found that the product did not show any prominent microbial or fungal growth throughout the period of storage of 3 months in the refrigerator as well as in room temperature. Since the both the products contained less than 0.2% of moisture, it was concluded that the shelf-life of the product was high due to the low moisture content [25].

3.5 Cost Calculation

Cost of the products were calculated and it was observed that Product S (INR 78) was the most expensive product, mainly due to the cost of the sunflower seeds, whereas Chocolate Delight (INR 53) (Product C1) and Caramel Crunch (INR 52) (Product C2) showed increased prices as compared to Product C (INR 50) mainly due to extra charges for incorporation of flavours like chocolate and caramel, since extra ingredients were required.

4. Conclusion

Nuts and oilseeds are a power house of essential nutrients which can aid in providing the quintessential nutrients to children which aids in their normal growth and development. They also provide a wide range of health benefits for growing children, which includes lowered serum lipid levels, prevention of diseases like coronary heart disease and attention deficit hyperactivity disorder (ADHD), juvenile diabetes and maintenance of lean body. It also provides micronutrients essential for growth [10].

The results of sensory evaluation (Table 3) indicated that the Product C containing 15g of flaxseed powder and 30g sesame seeds was most acceptable. The multi-nut spread developed was rich in proteins, omega fats, calcium and phosphorus. The ratio of omega 6 and omega 3 fatty acids was very close to the appropriate ratio [4.25:1] [8]. The developed product could be healthier alternative for children as compared to the ready to eat sweet spreads like jams, marmalades and chocolate spreads which are rich in sugar and fat.

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