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SNACKING A WAY TO OVERCOME PROTEIN ENERGY MALNUTRITION

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ABSTRACT

An attempt has been made for the development of high protein snacks using different sources of soya proteins (soy flour, soy milk and tofu) along with wheat flour, gram flour, green gram and parboiled rice. The prepared snacks were then packed in polypropylene (PP) and laminate pouches and were analyzed initially and after regular intervals of time for various physico-chemical and sensory quality attributes. Of the three different sources of soya proteins, snacks prepared using tofu was ranked best as compared to other sources. The results showed that initially the product (wheat flour + tofu + green gram+ gram flour + parboiled rice) had 3 % moisture content, 24 per cent fat, 2.3 per cent ash content and was organoleptically highly acceptable. Among the different packaging materials used in the study, snacks packed in laminated pouches were more acceptable as compared to polypropylene.

KEYWORDS: Soy flour, soymilk, soy tofu, green gram, par boiling, laminate and polypropylene.

INTRODUCTION

Additional foods are certainly a part of everyone's daily meals. Snacks are generally defined and considered as light quick meals, eaten between the main meals intended to assuage hunger or to satisfy the consumers craving for its taste (Nnam, 2003 and Matz, 1993). They are also known as convenient foods as they are quick and easy to eat. The term 'snack food' does not only apply to some of the newer products such as potato crisps, but it also includes many traditional food items. Snack foods are said to be very nutritious when made from fruits, pulses, or cereals. And consumption of these foods does not necessarily lead to health problems like obesity, but rather an unbalanced diet with excess fat, sugar and salt (Fellows and Hampton, 1992). Wholesome snacks boost energy, take the edge off appetite and most importantly provide useful nutrients needed for healthy growth, development and living (Karen, 2000). Lately, snacking is becoming prominent in the feeding of children, adolescents and working-class people (Madukwe et *al.*, 2013). Studies pertaining to the search of alternative source of nutrition and protein quality are of great importance in tropical developing countries to alleviate hunger and malnutrition particularly in children and pregnant women, as they are most vulnerable (Coulter et al., 1988; Pelletier, 1994). It is known that the cereal diets in developing countries deprive humans from indispensable amino acids and energy (Young and Pellet, 1990).

Practical Implication: The prepared product functions as a balanced product for the youngsters who feed and rely on snacks as their food.

Legume seeds of plant origin have nutrients that can be used to supplement the nutrient content of cereals especially the protein quality (Ene-Obong, 2008). Legumes are high in protein especially in the essential amino acids, lysine and tryptophan (which are lacking in cereals), fats and oil, minerals, vitamins, phyto-chemicals and carbohydrates. Hence when combined with cereals, legumes facilitate the formation of a new pattern of amino acid which is adequate (Enwere, 1998). Though legumes are deficient in the sulphur, aminoacids, cysteine and methionine, this deficiency is balanced when they are complemented with cereals (Obizoba, 1986). To ensure nutritional adequacy among the snack consuming population (children) who are the most vulnerable to nutritionally related diseases, consumption of blends of cereals and legumes have been recommended because of their low cost and nutritional quality (Ene-obong and Carnovale, 1992).

The soybean plant (Glycine max) belongs to the family legumenaise. On an average, a dry soybean contains roughly 40% protein, 20% oil, 35% soluble (sucrose, raffinose, stachyose, etc.) and insoluble (dietary fiber) carbohydrate, and 5% ash (Jooyandeh, 2011). Fresh soybean has approximately 14% moisture (Liu, 2004). Humans can easily digest soy protein products. About 92-100% of soy protein is digestible in humans (Riaz, 1999). Addition of parboiled rice to snacks also improves its nutritional value. The process of parboiling is likely to drives nutrients, especially thiamine from the bran to endosperm according to Kyritsi e*t al.* (2011) hence parboiled white rice is 80% nutritionally similar to brown rice. Parboiling increases the flavor and taste of the rice thus making it attractive to eat (Ayamdoo e*t al.*, 2013).

The main aim of the present study is to look in for a healthy and nutritious diet that can be provided to people without consuming much of their time and can be eaten any time to fulfill their nutritional requirement and can be enjoyed as well.

MATERIAL AND METHODS

Three different types of snacks were prepared by using soybeans in three different forms viz: soy flour, soymilk and tofu. All the ingredients were mixed properly and soft dough was made. The dough was then filled inside the kitchen press and snacks of desired shapes were obtained. Different flour/ Soymilk were blended with wheat flour and made into snacks as per proportions given in the following table.

(%) Concentrations of different ingredients used is shown as below

Treatments	Wheat flour	Soy flour	Tofu	Soy milk	Green gram	Gram flour	Parboiled rice
T_1	50	20	-	-	10	10	10
T_2	50	-	-	20	10	10	10
T_3	50	-	20	-	10	10	10

These snacks were then deep fried with good quality oil at a temperature of 180-200 ^{0}C for 3-4 minutes as described by Gamboa et al. (2015).

Wheat Flour + Soy (Flour/milk/tofu) + Green Gram + Gram Flour + Parboiled Rice

↓

Mixing (addition of salt, cumin, chili powder, Sod. bicarbonate)

↓

Kneading with water

↓

Dough Formation

↓

Extrusion (Normal Kitchen Press)

↓

Deep Frying (180 – 200 ^{0}C for 3-4 minutes)

↓

Draining

↓

Cooling

↓

Seasoning

↓

Packaging

Fig 1: Flow Sheet for the preparation of High Protein Snacks.

The snacks made from different flours/ Soy milk was blended with wheat flour. On basis of sensory evaluation best out of the three was packed in polypropylene and laminated pouches. The pouches were then sealed and kept under ambient conditions and were analyzed after every 15 days for a maximum period of 45 days.

Physico-chemical analysis

Moisture content: Ten grams of sample were dried in hot air oven at 70^{0}C in pre-weighed dishes till constant weight. The dish with dried sample was transferred to desiccators and cooled to room temperature. The dish was then weighed and moisture content in percent was calculated from loss in weight (AOAC, 2002).

$$\text{Per cent (\%) moisture} = \frac{\text{Loss in weight (g)}}{\text{Weight of sample (g)}} \times 100$$

Ash content: Five grams of the sample was weighed and transferred in a pre-weighed crucible and charred over the heater to make it smoke free. The crucible along with the sample was ignited at to 550-600^{0}C for 5 hours in a muffle furnace. When the muffle furnace was slightly cool, the crucible with ash was taken out, kept in a desiccator and weighed to a constant weight. The difference between the weight of silica crucible as empty and with ash was the amount of total ash (AOAC, 1995). The per cent ash was calculated from the following formula

$$\%\ Ash\ (dry\ basis) = \frac{weight\ of\ sample + crucible\ (before\ ashing)}{weight\ of\ sample + crucible\ (after\ ashing)} x100$$

Fat content: Five grams of dried sample was extracted with petroleum ether in soxhlet apparatus for 6 hours. The ether extract was filtered in pre-weighed beakers, petroleum ether was evaporated completely from the beaker and the increase in weight of the beaker represented the fat content (AOAC, 2000). Percent fat was calculated according to the following formula:

$$Per\ cent\ (\%)\ fat = \frac{initial\ weight\ of\ sample\ (g)}{final\ weight\ of\ sample\ (g)}\ x\ 100$$

Crude protein: Crude protein was estimated by micro-kjeldahl method, using the factor 6.25 for converting nitrogen content into crude protein (Sadasivam and Manickam, 1996). Weighed sample (2.0 g) was digested with 2 ml concentrated sulphuric acid and digestion mixture (2g K_2SO_4 and 80mg mercuric oxide) in kjeldahl digestion flask. The contents were cooled and volume was made up to 100ml. Measured aliquot was distilled with sodium hydroxide and liberated ammonia was collected quantitatively in 4 per cent boric acid solution containing a few drops of mixed (methyl red and bromocresol green) indicator. The boric acid solution was titrated against standardized 0.1 N H_2SO_4 and protein content was calculated using the equation given below:

$$Per\ cent\ Nitrogen = \frac{Titre\ value\ x\ 0.00014\ x\ volume\ made\ (ml)}{Aliquot\ taken\ (ml)\ x\ weight\ of\ sample\ (g)}\ x\ 100$$

Protein % = Nitrogen % x 6.25

Sensory Evaluation: Sensory evaluation depends upon the responses given by different sense organs. The samples were evaluated on the basis of appearance, taste, crispness and overall quality by semi-trained panel of 9-10 judges by using numerical scoring method with a scale ranging from 10-90 for each quality parameter (Amerine et *al*., 1965).

RESULTS AND DISCUSSION

Table 1: Estimation of bio-chemical composition of different ingredients used.

(%)	Wheat flour	Soy flour	Tofu	Soy milk	Green gram	Gram flour	Parboiled rice
Moisture	11.33	10.64	5.71	92.34	8.54	9.16	11.38
Crude Protein	11.49	43.76	29.65	3.91	21.44	23.65	5.78
Fat	1.98	20.78	16.67	1.97	1.86	5.14	2.53
Ash	0.83	3.16	3.67	0.76	2.43	2.61	1.94

Table 1 shows the moisture, protein, fat and ash content for wheat flour, soy flour, tofu, soymilk, green gram, gram flour and parboiled rice. These results are comparable with previous reports (Ngozi, 2014; Hussein et *al*. 2013; Banureka and Mahendran, 2009; Farzana and Mohajan, 2015; Banureka and Mahendran, 2009; Gandhi, 2009; Wang et *al*. 1963; Ifesan and Oguntoyinbo, 2012). Low moisture content in food samples is a desirable phenomenon, since the microbial activity is reduced, as reported by Ijarotimi (2012).

On the basis of sensory evaluation the snacks prepared by using tofu (as soy protein source), green gram, wheat flour, gram flour and parboiled rice i.e. Treatment T_3 were considered to be the best snacks and were studied under two different types of packaging materials (laminate and poly propylene) for a period of 45 days. The packets were studied on the basis of moisture content, per cent ash content, per cent fat content per cent protein and sensory evaluation after every 15 days. Results (Table 2) showed that blended snacks have higher moisture, ash and fat content. These results are in agreement with Mariam, 2005, who blended three different types of complementary foods with different composition of cereals and legumes for the preparation of weaning foods and found that most of the nutrient values were higher in local cereal and legume blends than in cerelac products when compared. Initially the moisture content was 3.13 % and on 15th day of storage, slight increase in the moisture content to 3.45% in PP and 3.27 % in laminate packaging was found which further increased to 7.37% in PP and to 5.8% in laminate on 45th day of storage. The gain in moisture content during storage condition might be due to hygroscopic nature of dried product and storage environment (temperature, relative humidity) (Nagi et *al*., 2012). Butt et *al*. (2004) also reported that the moisture content was affected significantly due to storage, packaging and their interaction.

The interaction of the snacks with the packaging material led to various physico-chemical changes in the product so prepared as shown in Table 2; 3 and 4 and 5.

Table 2: Change in moisture content (%) of high protein snacks packed in laminate and Polypropylene at room temperature.

Storage Period (days)	Moisture Content (%)	
	Laminate	Polypropylene
0	3.13	3.13
15	3.27	3.45
30	3.91	5.26
45	5.83	7.37
Effect	C.D. (p=0.05)	
Treatment	0.01	
Storage	0.01	
Treatment x Storage	0.02	

There was a significant increase in moisture content in all the samples during storage. The moisture content of snacks packaged in polypropylene (PP) increased more than laminated packaging material due to the high rate of migration of water vapor from the storage environment into the packaging material. This finding is in agreement with the work done by Kumar and Mishra (2004). They reported that the moisture content of mango soy fortified yoghurt powder during accelerated storage gradually increased when packaged in high-density polypropylene (HDPP) and ALP. The laminated packages were most effective and least moisture could migrate through them. This was mainly due to the fact that aluminum foil is considered to have a very low water vapor transmission rate (WVTR) under humid condition (80%RH) (Bargale e*t al*. 1993).

Table 3: Change in protein content (%) of high protein snacks packed in laminate and Polypropylene at room temperature.

Storage Period (days)	Protein Content (%)	
	Laminate	Polypropylene
0	17.52	17.52
15	17.31	17.17
30	16.96	16.91
45	16.93	16.86
Effect	C.D. (p=0.05)	
Treatment	0.01	
Storage	0.01	
Treatment x Storage	0.02	

The crude protein content represented a decreasing trend with storage (Table 3). This is in accordance with Butt e*t al*. (2004) who reported that the crude protein content showed a decreasing trend with storage of wheat flour. It has been suggested that Maillard reaction initiated during heat treatment may be responsible for the continued degradation in protein quality during storage (Alkanhal, 2000).

Table 4: Change in fat content (%) of high protein snacks packed in laminate and Polypropylene at room temperature.

Storage Period (days)	Fat Content (%)	
	Laminate	Polypropylene
0	5.57	5.57
15	5.21	5.14
30	5.03	4.93
45	4.89	4.79
Effect	C.D. (p=0.05)	
Treatment	0.02	
Storage	0.01	
Treatment x Storage	0.02	

There was a progressive decrease in the fat content of the samples with time. The decrease may be attributed to the lipolytic activity of enzymes i.e. lipase and lipoxidase. The highest decrease in fat was seen in polypropylene than in snacks packed in laminate packages. Similar results were reported by Murugkar and Jha (2011) for soy flour.

Table 5: Change in ash content (%) of high protein snacks packed in laminate and Polypropylene at room temperature.

Storage Period (days)	Ash Content (%)	
	Laminate	Polypropylene
0	2.04	2.04
15	1.95	1.88
30	1.83	1.79
45	1.69	1.65
Effect	C.D. (p=0.05)	
Treatment	0.01	
Storage	0.01	
Treatment x Storage	0.01	

The ash content (Table 4) decreased with increase in storage interval. Similar results were reported by (Malik, 2014) for corn-peanut blended flakes packed in aluminium laminated pouches.

Table 6: Change in Sensory evaluation (overall acceptability) of high protein snacks packed in laminate and Polypropylene at room temperature.

Storage Period (days)	Sensory evaluation (overall acceptability)	
	Laminate	Polypropylene
0	8.33	8.33
15	8.00	7.56
30	7.48	6.13
45	6.86	5.49
Effect	C.D. (p=0.05)	
Treatment	NS	
Storage	0.01	
Treatment x Storage	0.01	

At the beginning the sensory score was highest in snacks, however during storage the taste score decreased in the same. During storage, peroxide value and acidity rises significantly that further enhance the lipolytic activity and thus rancidity, all these are the contributory factors towards decline of flavor and taste score (Shahzadi e*t al*. 2005). From overall acceptability (Table 5) a non-significant change in the sensory corresponds for each packaging material. Similar results were reported by Swain (2013) for dried sweet pepper packaged in: polypropylene (PP), Laminated Aluminum (Al) and High density polyethylene (HDPE).

CONCLUSION

The present study demonstrated the effect of packaging material on the fat, protein, ash, moisture gain and sensory score of snacks during storage period of 45 days. After a few days of storage, packaging materials significantly affected all the above response parameters except sensory score. Thus, Undesirable changes of color, aroma, taste and crispness induced by the physicochemical mechanisms could not have taken place during entire storage periods. In comparison with packages employed in the study, Laminate film having high moisture barrier material caused minimal change in moisture content of samples, and hence minimal quality deterioration of snacks. It is found that laminated snacks was least affected by the ambient storage atmosphere, may be selected for preserving snacks.

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