Research Article

Development and Organoleptic Evaluation of Nutritious Bars by Using Defatted Peanut Flour, Roasted Soybean Seeds for Gym Trainees

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Abstract

To develop the plant based nutritional bars for Gym trainees who commonly use commercial supplements to improve their muscles. To prepare bars, defatted peanut flour and roasted and crushed soybean seeds were used. Three bars i.e. commercial bar, peanut and soya bar were evaluated organoleptically. The highest score for overall acceptability was obtained by peanut and soya bar and minimum by commercial bar. Statistically significant difference in overall acceptability scores of developed bars when stored for a period of two months and also in proximate composition of three bars, the peanut bar being more nutritious in terms of protein16.79% and fat 7.73%. The amino acid content and in vitro protein digestibility was maximum in peanut and soya bar than the commercial bar. Developed bars could be recommended as they are cost effective and highly nutritious than commercial bars to increase muscle mass for gym trainees involved in resistance exercise.

Keywords: Nutritional bar, defatted peanut flour, organoleptic evaluation, resistance exercise

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Introduction

Building muscles by consuming plant-based foods is not as difficult as it sounds there is a wide range of foods that are rich in complex carbohydrates, protein and healthy fats. In recent times in Western countries nut consumption has increased because of their excellent source of protein and often has a high content of L-arginine and also the presence of other bioactive molecules which make the addition of nuts to healthy diets [1]. Defatted peanut flour (DPF) is called the meal left after extraction of oil and is an inexpensive, protein-rich and less utilized product which offers the similar health and dietary advantages of peanut with low fat [2]. In general high essential amino acid content and high quality protein was contained by DPF at 47-55 per cent [3]. Soybean is one of the most inexpensive and valuable agricultural product because of its unique chemical composition. It has the highest protein content (around 40%), among the cereal and pulses species [4]. Many gym trainees use whey protein commonly as supplementation, alongside resistance exercise to help in improvement of muscle protein synthesis. However, consuming severely high doses can result in loss of calcium from bones which can increase the risk of osteoporosis [5] and can place a stress on the kidneys due to increased levels of ketones which are waste product of protein metabolism [6].

Material and Methods

Procurement and processing of raw materials

Different ingredients for the development of nutritional supplement like raw peanuts, roasted soybean seeds, oats, skimmed milk powder and honey were procured from the local market of Ludhiana.

Preparation of peanut flour

Peanuts were purchased and checked for any infestation or damage, were then roasted, de-skinned and oil was extracted by using oil extraction machine at the local market in Ludhiana. The cake was ground finely to the powder form.

Development and standardization of Nutritious Bars

Two nutritious bars namely Peanut bar and Soya bar were developed and standardized at different levels in which ingredients like peanuts, partially defatted peanut flour, roasted soybean seeds, oats, skimmed milk powder and honey

were used. The nutritional bars were prepared in the food laboratory of department of Food and Nutrition, College of Home Science, Punjab Agricultural University, Ludhiana. Peanut bar was first standardized with different levels (5%, 10% and 15%) of peanut flour and same in case of soya bar which was also standardized with different levels (15%, 20% and 25%) of roasted soybean seeds. The acceptability was checked on the basis of binding capacity, Peanut bar was acceptable at 10 per cent incorporation of peanut flour while soya bar was acceptable at 20 per cent incorporation of roasted soybean seeds. The nutrients of both the bars were then calculated which could meet up the requirements of gym trainees i.e. protein and carbohydrate rich and low fat content nutritional bar in 100g of bar.

Standardized recipe of nutritional supplements

Peanut Bar

Ingredients Peanut flour - 10g, Oats - 20g, Skimmed milk powder - 20g, Honey - 40g, Roasted peanuts crushed - 10g

Method

- Roast peanut flour in a heavy bottom pan for 2-3 min. on medium heat.
- Now roast oats for 5-6 min. till it changes its color to light brown.
- Roast peanuts and remove skin and crush them.
- Put all ingredients in a bowl and also add skimmed milk powder and honey, now press gently to bind all ingredients together.

Total cooked weight - 100g
No. of servings - 1
Cost per serving - `30

Soya Bar

Ingredients Roasted Soybean (crushed) - 10g, Oats - 20g, Skimmed milk powder - 20g, Honey - 40g, Roasted Soybean (granulated) - 10g

Method

- Grind roasted soybean in a mixer grinder to crush them completely and then grind some roasted soybean to granules.
- Now roast oats for 5-6 min. till it changes its color to light brown.
- Put all ingredients in a bowl and also add skimmed milk powder and honey, now press gently to bind all ingredients together.

Total cooked weight - 100g
No. of servings - 1
Cost per serving - `30

Cost of Control (commercial bar) - 30 g for `30

Sensory characteristics

The developed bars were organoleptically evaluated by semi trained panel of 10 judges from the Department of Food and Nutrition, College of Home Science, Punjab Agricultural University, Ludhiana. The judges were served each preparation with a control sample and two test samples. Control sample was commercially prepared bar and the test samples were prepared by supplementing with defatted peanut cake flour and roasted soybean seeds. The samples were coded to avoid any biased judgment. Each bar was tested in triplicate and mean scores were calculated. Judges were asked to score the sample for appearance, color, texture, flavor, and overall acceptability Larmond [7] using a score card of nine-point Hedonic rating scale.

Shelf life estimation

To assess the shelf life of nutritious bars, peanut bar and soya bar were packed in plastic zip lock pouch. They were stored in refrigerator at 4-7°*C* for two months. Sensory evaluation of the products were conducted at interval of one month of storage, for two months by semi trained panel of 10 judges from the Department of Food and Nutrition, College of Home Science, Punjab Agricultural University, Ludhiana..

Nutritional analysis

Proximate composition
Proximate composition will be estimated by employing standard methods of analysis by AOAC [8]

Amino acid profile
Amono acid profile were analyzed which includes Available Lysine by Booth [9], Methionine by Horn *et al* [10], Cysteine by Liddell and Saville [11] and Tryptophan by Concon[12].

In vitro protein digestibility
Estimation of in vitro protein digestibility was done by Akeson and Stachman [13] method.

Statistical Analysis
The data was analysed with the help of statistical tool such as mean score. To test the significant difference between the commercial and experimental samples kruskal Wallis Test was used and T-test was applied for the acceptability of the products after storage period of two months. Analysis of variance and critical difference was applied to compare nutritional parameters using SPSS 16 software.

Results and Discussion

Organoleptic evaluation

Two nutritious bars namely peanut bar and soya bar were developed using different ingredients like defatted peanut flour, peanuts whole and crushed roasted soybean seeds, oats, skimmed milk powder, and honey as common ingredients. The development of the products was carried out to develop bars having high protein and carbohydrates and low fat content which could meet up the requirements of gym trainees and have acceptable proportion of partially defatted peanut cake flour and roasted soybean seeds. Each of the developed bar was evaluated by ten semi trained panelists of department of Food and Nutrition, College of Home Science, Punjab Agricultural University using 9 point Hedonic scale.

The average sensory scores obtained for bars are given in **Table 1**. The incorporation was done at different levels and on the basis of requirements the bar with 10 per cent level was most acceptable in terms of both nutritional and binding capacity. Control (C) sample was a commercial bar. Peanut Bar obtained the highest scores among the three bars with respect to appearance, colour, texture, flavor and taste. It was found that soya bar was also acceptable. The highest score for overall acceptability of 8.0 was obtained by the peanut bar followed by soya bar 7.87 and least score 7.49 was obtained for commercial bar. Statistically significant (p<0.05) difference was found among the three bars. The mean score obtained for colour was highest for peanut bar i.e. (8.00) among the three bars. Although overall acceptability was statistically insignificant but peanut bar scored highest. Similar study was conducted by Velagapudi and Ramaswamy [14]. They found that the organoleptic evaluation show that nutrient cum peanut bar supplement taste, appearance had obtained a mean score of 4.5 out of 5 for overall acceptability and therefore highly acceptable the attributes score for appearance, colour, flavour, texture, taste and overall acceptability. Witting [15] reported that soy-based candy bars indicated a very good sensory and microbiological quality.

Table 1 Mean sensory scores for commercial bar and developed peanut and soya bar N=10

Products	Parameters					
	Appearance	**Colour**	**Texture**	**Aroma**	**Taste**	**Overall Acceptability**
Commercial Bar	7.50	7.54	7.36	7.58	7.58	7.49
Peanut Bar	7.94	8.04	7.86	8.03	8.03	8.00
Soya Bar	7.87	7.89	7.8	7.92	7.93	7.87
Kw value	4.43^{NS}	6.89*	3.0^{NS}	2.25^{NS}	2.00^{NS}	4.06^{NS}

*significant at 5% level (p<0.05) NS- Non significant

Shelf life estimation

The developed bars were stored in plastic zip lock pouch for a period of two months to check their shelf life. The bars were subjected to sensory evaluation at interval of one month for two months. The sensory scores obtained for the bars are presented in **Table 2**. Two bars were developed using defatted peanut flour and roasted soybean seeds. The higher score for mean overall acceptability was 7.75 for peanut bar stored for a period of two months. Statistically insignificant difference in the scores for appearance, colour, texture, aroma and taste was observed between the bars. Statistically significant difference (p<0.1) was observed in overall acceptability between the two bars, peanut bar being more acceptable i.e. 7.75. Lobato*et al* [16] reported that the hardness, water activity and darkness of the snack bars increased with storage time. The content of moisture of the cereal bars likely to increase, which tend to influence on the characteristics of texture breaking hardness and strength under environmental conditions of relative humidity (56%) and temperature (25 ± 2 degrees C) also the increase in the values for breaking strength was attributed to a possible crystallization of the agglutinating syrup used for the bars at 45 days of storage Freitas [17].

Table 2 Mean sensory scores of developed nutritional bars after storage N=10

Products	**Parameters**					
	Appearance	**Colour**	**Texture**	**Aroma**	**Taste**	**Overall Acceptability**
Peanut Bar	7.85	7.85	7.65	7.6	7.7	7.75
Soya Bar	7.75	7.7	7.35	7.35	7.45	7.44
t- value	0.53^{NS}	0.90^{NS}	1.17^{NS}	1.12^{NS}	1.20^{NS}	1.69**
** Significant at 10% level (p<0.1)						

Nutritional evaluation

Proximate composition

Result of **Table 3** revealed that there is a significant difference among all the three bars and the developed bars were significantly higher than the commercial bar in terms of protein. Comparison between developed nutritional supplements i.e. peanut and soya bar was observed to be significantly different (p<0.05) in case of protein and ash content. The protein and ash content of peanut bar was observed to be higher i.e. 16.79 and 9.89 per cent than that of soya bar i.e. 16.28 and 8.64 per cent, respectively. No significant difference was found in moisture, fat, fiber, carbohydrates and energy value. The developed bars were high in moisture, fat, carbohydrates and energy value of the soya bar was observed whereas fiber content of peanut bar was higher i.e. 1.46 per cent. Sawaya *et al* [18] reported that the content of protein in bars can also be increased by fortification of peanut and soy flour. Although, fortification of date bars with these sources increases protein, fiber and ash contents and without affecting their sensory acceptability it improves minerals such as Ca, Mg, Na, K, P, Zn and essential amino acids. Pallavi [19] reported that nutra *chikki*a, popular Indian traditional sweet snack prepared from peanut had 18% protein, 20% fat, 6.42% Ca, 1.7% Fe, 4000 µg vitamin A and 2660 µg folic acid.

Table 3 Proximate composition of developed nutritional bars (DW basis)

Products	**Moisture (%)**	**Crude Protein (%)**	**Crude Fat (%)**	**Crude Fiber (%)**	**Total Ash (%)**	**Carbohy-drates (%)(by differences)**	**Energy (Kcal/100g)**
Commercial bar	2.54±0.20	10.65±0.35	13.10±0.28	3.3±0.71	1.28±0.57	69.09±1.61	437±6. 98
Peanut Bar	3.79±0.20	16.79±0.35	7.73±0.28	1.46±0.71	9.89±0.57	60.34±1.61	378±6.98
Soya Bar	3.90±0.11	16.28±0.51	7.94±0.41	1.32±0.67	8.64±0.85	61.92±0.71	380±2.91
Critical difference at 5%	0.12	0.42	0.44	0.53	0.59	1.05	4.01
Values are given as Mean ±SD							

Amino Acid Profile

The amino acid namely lysine, methionine, cysteine and tryptophan content were analyzed in commercial bar and in the developed peanut and soya bar. The results are presented in **Table 4**. The amino acid content was maximum in peanut bar followed by soya bar and minimum was in commercial bar except for methionine content which was higher in commercial bar than soya bar. Statistically significant (p<0.05) difference in the lysine content of the three bars was observed. Highest lysine content was observed in peanut bar on the addition of partially defatted peanut cake flour followed by soya bar. Singh [20] reported that the incorporation of defatted groundnut flour results in

improvement of ease in baking, texture, and appearance of the final product and the increase in protein content percentage at the 30% level of fortification varied from 53% to 122%. Significant increases in all essential amino acids. Omwamba and Mahungu [21] reported a concentration of 88-90mg per 100 g lysine content in protein rich ready to eat extruded snacks from a composite blend of rice, sorghum and soybean flour.

Methionine and cystine content among the products was highest for peanut bar on the addition of partially defatted peanut cake flour i.e. 224.3 and 35.51mg/100g, respectively followed by soya bar i.e. 134.2 and 28.76mg/100g, respectively. Statistically significant ($p<0.05$) increase in the methionine and cystine content was found and it was due to the addition of partially defatted peanut cake flour which has a high amino acid and protein profile. Combination of soybean/wheat and Bambara groundnut/wheat composite flours and biscuits were investigated by Ojimelukwe *et al* [22] and they observed that the amino acid composition and protein quality of lysine and the sulphur containing amino acids (methionine, cystine and trytophan), which are known to be limiting in both cereals and legumes were significantly improved ($p<0.05$) in the composite blends. Khanam and coworkers [23] also reported that supplementary foods prepared by incorporating soy protein concentrate, whey protein concentrate along with green gram dhal flour to roasted wheat flour increased the methionine content significantly and was more than the recommended pattern given by FAO/WHO for supplementary foods.

The tryptophan content among the products was highest and statistically significant increased ($p<0.05$) for peanut bar on the addition of partially defatted peanut cake flour i.e. 296.5 mg/100g followed by soya bar i.e. 281.9mg/100g. Like cereals, legumes also contain tryptophan in free form and bound to proteins. Peanut flour showed the higher value than chickpea, broad bean, lentil and vetch flours. Hence, peanut bar was a quality protein bar.

Table 4 Amino Acid content of developed nutritional bars

Products	Lysine (mg/100g)	Methionine (mg/100g)	Cystine (mg/100g)	Tryptophan (mg/100g)
Commercial Bar	349.3±1.46	161.9±1.01	15.6±0.04	184.7±2.23
Peanut Bar	466.4±2.13	224.3±2.97	35.51±0.02	296.5±1.63
Soya Bar	434.5±2.84	134.2±2.43	28.76±0.18	281.9±2.33
Critical Difference at 5%	2.02	2.09	0.09	1.91
Values are given as Mean ±SD				

In- vitro protein digestibility

The digestibility is an important criterion that determines the availability of physiologically active amino acids and peptides and is affected by processing treatments. A significant difference was observed in all the three bars. The highest in -vitro protein digestibility was observed in peanut bar i.e. 42.88 per cent due to the addition of partially defatted peanut cake flour followed by soybean bar i.e. 35.34 per cent and minimum in commercial bar 22.23 per cent as shown in **Table 5**.

In vitro protein digestibility of raw peanuts was found to be 92.65 per cent Abdualrahman [24] while for partially defatted peanut cake flour it was found to be 98.99 per cent Zhao *et al* [25]. The authors reported that the processing of peanut to flour reduces the antinutritional component which in turn increases in -vitro protein digestibility and protein availability. In vitro protein digestibility (IVPD) of wheat flour was 30% and it increased to 40 per cent when supplemented with peanut meal and showed a considerable improvement in *in- vitro* protein digestibility in Sorghum-based kisra, was observed when it was supplemented with peanut flour. An increased *in-vitro* protein digestibility with a high amino acid profile in flake snack, instant beverage, and instant soup prepared using rice flour, soybean flour, black sesame seed, and rice bran oil were reported by Satusap *et al* [26]. Dhanesh [27] also reported increase in *in-vitro* protein digestibility of products prepared from wheat, chickpea flour, partially defatted peanut cake flour, fenugreek leaf powder and spinach leaf powder.

Table 5 *In-vitro* protein digestibility of developed nutritious bars

Products	*In-vitro* protein digestibility (%)
Commercial Bar	22.23±0.73
Peanut Bar	42.88±1.66
Soya Bar	35.34±2.47
CD	2.83
Values are given as Mean ±SD	

Conclusion

The study concluded that both the bars were organoleptically acceptable but peanut bar was highly acceptable also the shelf life of peanut bar was acceptable till two months of storage. The developed nutritional bar was found to be high in energy, protein, and carbohydrates with good amounts of amino acid profileand high protein digestibility. Hence, it is recommended that plant based foods are better in terms of sensory attributes, rich in nutrients and are inexpensive than the synthetic powders and have no ill effect on health. Hence the developed bar could be recommended for gym trainees.

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