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FORMULATION AND SENSORY EVALUATION OF NUTRITIOUS SNACKBAR ENRICHED WITH SOY FLOUR FOR ADOLESCENCE

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Abstract

During Adolescence dietary and energy needs are elevated because of the increased growth rate and modifications in body composition related to puberty. Hence nutritious snacks facilitate in meeting the elevated requirement of Adolescence. In the current review, efforts have been made to formulate a Healthy, Ready to eat, Crunchy Nutritious snack bar rich in Protein, Dietary fibre, Calcium and Iron. They were formulated using dry raw materials (peanuts, amaranth seeds, oats, flax seeds, sesame seeds, milk powder, soy flour) and binding agents(jaggery, oil). Sample 1 was control, where soy flour was not added, five different Variants were prepared which were enriched with soyflour at different ratios of 2.5,5,7.5,10,12.5 respectively.Sensory evaluation has been conducted, based on statistical analysis of sensory attributes, the most acceptable sample was subjected for its Nutrient and shelf-life analysis which were conducted professionally. The Sensory scores of the most Acceptable sample 5 after control (sample 1) accounted for Appearance(82%) texture(82%), Taste(84%), Aroma(86%), Overall acceptance(92%).

The Microbiological quality of sample was inspected for Total viable count(<10⁴), Coliform, Yeast and Mold (<10²) E coli, Salmonella and Staphylococcus aureus (absent).The product was found to be stable for 1 month.

Keywords: Adolescence, Convenient Foods, Nutritious Snackbar, Sensory Evaluation.

Introduction

A Snack refers to a minor meal consumed between the major meals, i.e., breakfast, lunch, and dinner.Certain foods like potato chips /cookies are considered as unhealthy due to low nutritional quality (e.g.high fat ,added sugars; or low fiber) are also referred to as snacks. [1]

American Heritage dictionary defines snack as “hurried or light meal” or “food eaten between meals.” Traditionally, snack foods appeal to consumers on a number of levels such as taste, appearance, texture etc. [2]

Bars are ready to eat food which are balanced in terms of both macro and micronutrients such as carbohydrates, protein, fat, minerals, vitamins, calories, and they are also marketed to sportsperson for energy.[3]

Increased nutritional needs among teenagers can be met by adding important nutrients such as Proteins and Calcium and also helps to overcome nutritional deficiencies. Considering the likes and preferences of teenagers use of homemade products is not only a healthy; but also, a capable and cost-effective means to reach teenagers.[4]

Grain amaranthus is unique because of its nutritional characteristics serving a good source of protein, micronutrients and phytochemicals. When compared to other cereals pearl millet and amaranthus have a better amino acid profile.Comparatively lysine content is 2–3 times higher in amaranthus while niacin content is higher in pearl millet.[5]

Peanuts are a good source of vital nutrients such as proteins, carbohydrates, lipids, vitamins, minerals and fiber to the human body It also contains poly unsaturated and monounsaturated fatty acids that can increase the levels of HDL cholesterol which are considered good for heart. Presence of Essential amino acids that are not synthesized in the body but are important as they are the building blocks of proteins and carbohydrates. A diet including peanuts play an important role in preventing disease and maintaining good health.[6]

Oats are excellent source of soluble dietary fiber mainly β-glucan having functional and nutritional properties. The major active component in oats is beta glucan as it has cholesterol-lowering and antidiabetic effects. The nutritional benefits of oats are more than that of fiber to bioactive phytochemicals having strong antioxidant and anti-inflammatory effects.[7]

Soybean has high quality protein along with low saturated fat and no cholesterol, high in dietary fiber. soybean consumption appears to decrease the risk of cardiovascular diseases with improved glycemic control. In individuals with type 2 diabetes, soybean can be given as there are some other common diseases associated with it like hypertension, hypercholesterolemia, atherosclerosis and



obesity. It might also decrease the risk of renal disease in type 2 diabetes by substituting animal protein for soybean or other vegetable protein. Usually, it is accepted that a high fiber diet, particularly soluble fiber, helps in better controlling plasma glucose concentration in diabetics.[8]

Protein present in flax seeds helps in preventing and treating heart disease while supporting the immune system. It is considered as important functional food ingredient as its high in α -linolenic acid (ALA, omega-3 fatty acid), lignans, and fiber having potential health benefits such as in decreasing the risk of cardiovascular disease, atherosclerosis, diabetes, cancer, arthritis, osteoporosis, autoimmune and neurological disorders. [9]

Sesame seeds being highly nutritious is an excellent source of copper, a very good source of manganese, and a good source of magnesium, calcium, phosphorus, iron, zinc, molybdenum, and selenium and also has good fatty acid profile. Jaggery has protein, minerals, vitamins, iron and copper in it.[10]

Shelf life of milk is increased when it is converted to milk powder, allowing it to be stored for prolonged duration (about 1 year) without much loss of quality, even at room temperatures. The dairy-based powders are used as a food ingredient in numerous “value-added foods” such as confectionery, bakery, and meat products, it is also used for recombination or reconstitution. [11]

Jaggery is the no centrifugal sugar prepared from sugarcane juice which has many nutritional and medicinal properties like anticarcinogenic and antitoxic activity due to the presence of micronutrients in it. It provides instant energy to a human body and is considered better when compared to that of white sugar.[12]

Materials and Methodology

1.Ingredients

Jaggery, Peanuts, Amaranth seeds, Flax seeds, Sesame seeds, Defatted Soy Flour (Harima), Oats (Quaker), Milk powder (Nestle Every day), Oil (Gold drop) were procured from a local market of Hyderabad, India.

2.Nutritious Snackbar preparation

Six samples of Nutribar were prepared using one sample as the control containing popped Amaranth seeds, Peanuts and Oats as the base and sample two to sample six were enriched with soy flour while keeping the other ingredients at constant except oats that was altered. The quantity of raw ingredients are given in the table 1 soy flour and oats blends were made in the ratio of 0:12.5, 2.5:10, 5:7.5, 7.5:5, 10:2.5, 12.5:0 respectively.

In a pan oil was added and heated followed by the addition of Peanuts, Popped Amaranth Seeds, Oats, Flax seeds and Sesame seeds till they attain brown colour. All the roasted ingredients were added to the melted jaggery and mixed well manually to ensure uniformity.

The mixture was then shaped in rectangular moulds to obtain bars.

Sample 1 was control, where soy flour was not added, five different Variants were prepared which were enriched with soy flour at different ratios given below in table 1

Table 1: Composition of Nutritious Snackbars

Ingredients	Sample1 T0	Sample2 T1	Sample3 T2	Sample-4 T3	Sample-5 T4	Sample6 T5
Jaggery	75	75	75	75	75	75
Rajgira	20	20	20	20	20	20
Peanuts	25	25	25	25	25	25
Oats	12.5	10	7.5	5	2.5	0
Soy Flour	0	2.5	5	7.5	10	12.5
Flax Seeds	6.25	6.25	6.25	6.25	6.25	6.25
Sesame Seeds	6.25	6.25	6.25	6.25	6.25	6.25
Milk Powder	25	25	25	25	25	25
Oil	7.5	7.5	7.5	7.5	7.5	7.5



3.Sensory Evaluation

The sensory evaluation of different parameters like Appearance, Texture, Taste, Aroma, and Overall acceptability of Nutritious snack bars was analysed using a 5-point Hedonic scale. A total of 50 untrained panelists were opted randomly as panelists. Organoleptic evaluation was carried out on six different samples using a 5-point hedonic scale, ranges from 5- like a lot to 1 – dislike a lot.

4.Shelf-life study

Based on the results of sensory attributes of six different variations, sample 5 was subjected to microbial, chemical and organoleptic analysis. The results of shelf-life study are presented in table no. 5 and 6.

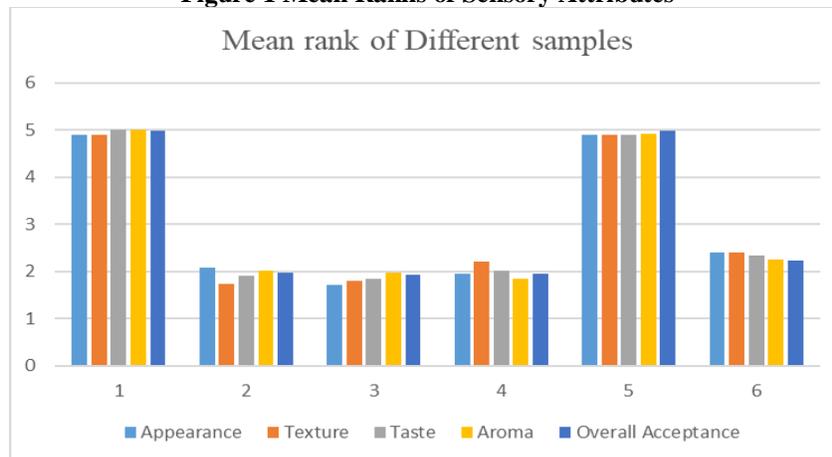
Results and Discussions

To know the significant difference between the six different samples by the information obtained from sensory evaluation (where n=50) statistically, chi square test, advance tests like Krushkal-Wallis test were performed.

Table: 2 Mean rank of Different Samples

Samples		Appearance	Texture	Taste	Aroma	Overall Acceptance
1	Mean	4.96	4.99	5.00	5.01	4.98
	N	50	50	50	50	50
2	Mean	2.08	1.73	1.91	2.02	1.97
	N	50	50	50	50	50
3	Mean	1.72	1.80	1.85	1.98	1.93
	N	50	50	50	50	50
4	Mean	1.95	2.21	2.02	1.84	1.96
	N	50	50	50	50	50
5	Mean	4.9	4.89	4.90	4.93	4.98
	N	50	50	50	50	50
6	Mean	2.41	2.41	2.34	2.25	2.22
	N	50	50	50	50	50

Figure 1 Mean Ranks of Sensory Attributes



Appearance - Appearance of the sample 1 was more preferred followed by sample 5 with 86% and 82% respectively accounted for “Like Extremely”. Followed by sample 2, 4, 3, 6 with 76%, 72%, 56% and 42% respectively accounted for “Neither like nor Dislike”. Lineardependence of the variables is stronger. ThePearsonchi-square value is 281.036^a and the likelihood ratio is 334.759.Theasymptomatic significance of Pearsonchi-square and likelihood ratio is 0.000. **As the values are less than 0.05, all the values are significant.**



Texture - Texture of sample 1 followed by sample V with 90% and 82% respectively accounted for "Like Extremely". Followed by the sample 3, 4, 6, 2 with 66% ,56%, 50.0% and 40% respectively accounted for "Neither like nor Dislike". The Pearsonchi-square value is 277.976 and the likelihood ratio is 341.164. The asymptomatic significance of Pearsonchi-square and likelihood ratio is 0.000. **As the values are less than 0.05 all the values are significant.**

Taste - Taste of the sample 1 followed by sample 5 with 92% and 84% respectively accounting for "liked extremely", followed by the sample 2, 3, 4, 6 with 68%, 62% 56% and 44% respectively accounted for "Neither like nor Dislike". Linear dependence of the variables is stronger. The PearsonChi-square values is and the 284.599^a likelihood ratio is 352. 645.The asymptomatic significance of Pearsonchi-square and likelihood ratio is 0.000, **As the values are less than 0.05 all the values are significant.**

Aroma - The aroma of sample 1 followed by sample 5 with 92% and 86% respectively accounted for "Like Extremely", followed by the samples 3, 2, 4, 6 with 70%, 66%, 52%, 46% respectively accounted for "Neither Like nor Dislike" Linear dependence of the variables is stronger. The PearsonChi-square values is 284.584^a and the likelihood ratio is 350. 161.The asymptomatic significance of Pearsonchi-square and likelihood ratio is 0.000, **As the values are less than 0.05 all the values are significant.**

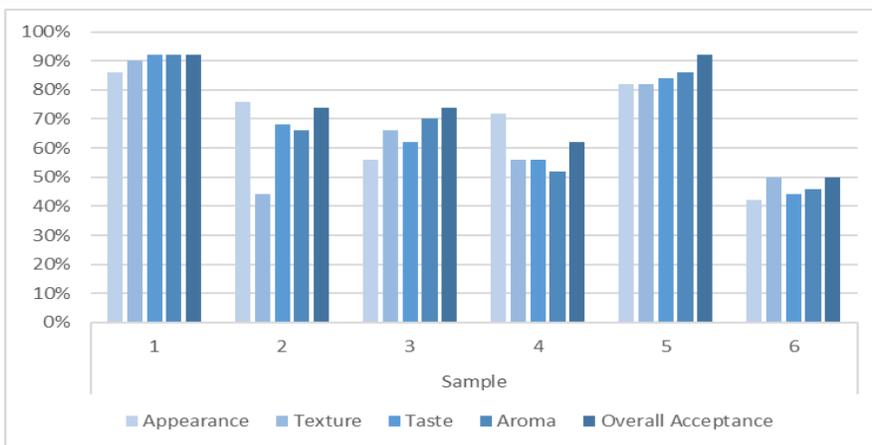
Overall Acceptance - The overall acceptance of sample 1 and 5 was 92% accounted for "Like Extremely", followed by the samples 2, 3 with 74%, followedby Sample 4 with 62%, sample 6 with 50% which accounted for "Neither Like nor Dislike" Linear dependance of the variables is stronger. The pearson Chisquare values is 290.125^a and the likelihood ratio is 356. 122.The asymptomatic significance of pearson chisquare and likelihood ratio is 0.000, **As the values are less than 0.05 all the values are significant.**

All the values were significant and statistically different except for sample 1 and 5 where the values were found almost similar. As per the results obtained from one way ANOVA and Krushkal-Wallis test, it is evident that sample 1 and 5 is preferred over other samples statistically. As the sample 1 was control, the sample 5 i.e enriched with 10% soy flour was most acceptable over others.

Table 3: Percentages within the different samples

Cross tab			Sample					
			1	2	3	4	5	6
Appearance	1	Count	43	38	28	36	41	21
		% within sample	86%	76%	56%	72%	82%	42%
Texture	2	Count	45	22	33	28	41	25
		% within sample	90%	44%	66%	56%	82%	50%
Taste	3	Count	46	34	31	28	42	22
		% within sample	92%	68%	62%	56%	84%	44%
Aroma	4	Count	46	33	35	26	43	23
		% within sample	92%	66%	70%	52%	86%	46%
Overall Acceptance	5	Count	46	37	37	31	46	25
		% within sample	92%	74%	74%	62%	92%	50%

Figure 2: Percentages within the different samples



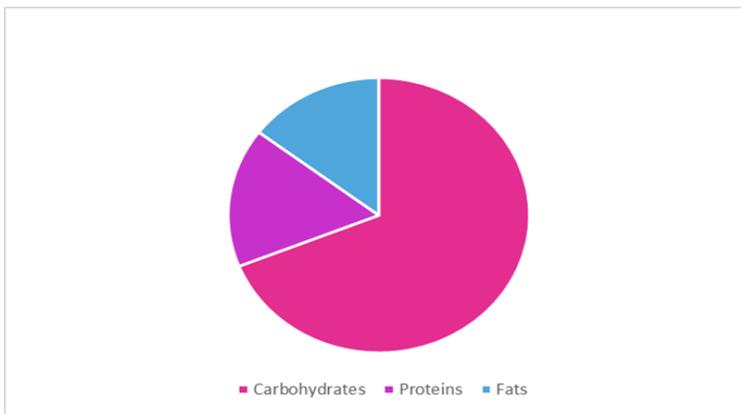
Nutrient Analysis

The test sample with the highest overall acceptability i.e the sample 5 was analysed for its Energy using SOP-CHM-29-00 were 453.37 k.cal/ 100gm ,Carbohydrate using SOP-CHM-28-00 were 66.04 gm/100gm providing 264.14 cal, Protein using FSSAI Manual 3(8.7):2016 were 15.69gm/100gm providing 62.6 cal, Fat using FSSAI Manual 3(14.5):2016 were 14.05 gm/100gm providing 126.45 cal, Sugar using FSSAI Manual 5(2.6):2016 were 39.37 gm/100gm, Dietary fibre using AOAC 985.29 20th E D were 8.17gm/100gm, Calcium using SOP-CHM-27-00 were 330.08 gm/100gm and Iron using SOP-CHM27-00 method were 4.63gm/100gm.

Table 4 Nutrient Analysis

Sr.No.	Parameters	Units	Methods	Results of Analysis
1	Energy	Kcal/100g	SOP-CHM-29-00	453.37
2	Carbohydrate	g/100g	SOP-CHM-28-00	66.04
3	Protein	g/100g	By FSSAI Manual - 3 (8.7) : 2016	15.69
4	Fat	g/100g	By FSSAI Manual - 3 (14.5) : 2016	14.05
5	Sugar	g/100g	By FSSAI Manual - 5 (2.6) : 2016	39.37
6	Dietary Fibre	g/100g	AOAC 985.29 20th Ed.	8.17
7	Calcium	mg/100g	SOP-CHM-27-00	330.08
8	Iron	mg/100g	SOP-CHM-27-00	4.63

Figure 3 Proximate composition of Nutritious snackbar



Microbiological Analysis

The test sample with the highest overall acceptability was analysed at the zero day (immediately after receiving the sample) and after one week of accelerated conditions (1 month). The Total viable count accounted for 6.9×10^3 cfu/gon zero time and 7.0×10^3 cfu/g in one week of accelerated conditions, Coliform accounted for 9.0×10^1 cfu/gon zero day and 9.0×10^1 cfu/g one week of accelerated conditions, Ecoli and salmonella were absent on both zero day and one week of accelerated conditions, yeast and mould were less than 10cfu/g on both zero day and one week of accelerated conditions.

Table 5: Microbiological Analysis

Tests	Units	Zero Time	After 1 week in accelerated conditions equivalent to 1 month	Specified Limits
Total viable count	cfu/g	6.9×10^3	7.0×10^3	Max 10^4
Coliform	cfu/g	9.0×10^1	9.0×10^1	Max 10^2
E coli	org/g	Absent	Absent	Absent
Salmonella	org/25g	Absent	Absent	Absent
Staphylococcus aureus	org/g	Absent	Absent	Absent
Yeast	cfu/g	<10	<10	Max 10^2
Mold	cfu/g	<10	<10	Max 10^2

Chemical Analysis

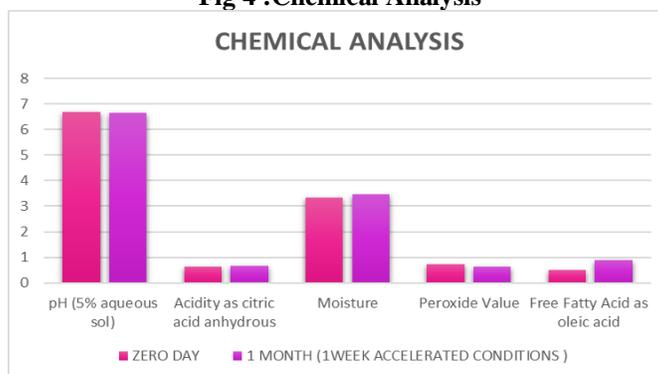
The test sample with the highest overall acceptability was analysed for its PH (5% Aqueous sol) by FSSAI Manual – 5(2.3):2016 were 6.69 on zero day and 6.64 in one week of accelerated conditions, Acidity as citric acid anhydrous by FSSAI Manual – 5(2.4):2016 were 0.63 g/100gm on zero day and 0.66 g/100gm in one week of accelerated conditions, Moisture by FSSAI Manual 3(8.1):2016 3.35 g/100g on zero day and 3.48 g/100g in one week of accelerated conditions, peroxide value by FSSAI Manual 2(37.0):2016 were 0.72 meq/kg on zero day and 0.62 meq/kg in one week of accelerated conditions, Free fatty acids by FSSAI Manual 2(11.0):2016 were 0.51 g/100g on zero day and 0.88 g/100g in one week of accelerated conditions.

Thus, the product has been passed in the shelf life of 1 month which was done in accelerated conditions of one week.

Table 6: Chemical Analysis

Tests	Units	Zero time	After 1 week in accelerated conditions equivalent to 1 month	Specified Limits
pH (5% aqueous sol)	-	6.69	6.64	Not Specified
Acidity as citric acid anhydrous	g/100g	0.63	0.66	Not Specified
Moisture	g/100g	3.35	3.48	Not Specified
Peroxide Value	meq/kg	0.72	0.62	Not Specified
Free Fatty Acid as Oleic Acid	g/100g	0.51	0.88	Not Specified

Fig 4 :Chemical Analysis



Organoleptic Evaluation

The formulated Nutritious SnackBar when analysed for the sensory attributes periodically at zeroth day and 1 month in accelerated conditions of one week respectively, did not undergo any significant changes in appearance, texture, taste, aroma and overall acceptance of the SnackBar and were scored 5 by the panelists throughout the storage period.

Table 7: Organoleptic Evaluation

Tests	Zero Time	After 1 week in accelerated conditions equivalent to 1 month	Specified Limits
Appearance in terms of colour	5	5	3-5
Odour	5	5	3-5
Taste	5	5	3-5
Texture/ Consistency	5	5	3-5

(1- dislike very much; 2- dislike moderately; 3- neither like nor dislike; 4- like moderately; 5- like very much)

From the above discussed points, it is evident that sample 5 is preferred over other samples in consumer acceptability apart from sample 1 which is the control.



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Conclusion

In the fast-paced world, consuming Nutritious and Healthy foods has risen to the top of people's priority lists. Healthy snacking is now an integral part of their regimen. In spite of shift towards Nutritious snacks, taste has not lost its place for the snack lovers. In fact, the Modern-age consumers not only explore Nutritious but also need Scrumptious products.

The product Nutritious snackbars developed in this research study enriched with Soy Flour, was found to be acceptable by Consumers and Nutrient Analysis indicated that the product developed has high content of Protein, Dietary Fibre, Calcium and Iron when compared to other bars available in the Market. According to the Shelf-life report there are no significant Chemical, Microbial and Sensory changes observed in the product throughout the storage period that is One month in Accelerated conditions without any addition of preservatives.

It may prove to be a healthy snack which is handy and portable to Adolescence to meet their body's development needs and also fulfil their craving for unhealthy snacks.

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