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INCORPORATION OF CHIA SEEDS IN FRUIT PUNCH, KHEER, SMOOTHIE AND ITS SENSORY EVALUATION

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ABSTRACT

Chia seeds are rich in antioxidants, dietary fiber, proteins, omega-3 and bone nutrients. It is also gluten free and improves blood biomarkers. Chia seed consumption is less in India in main meals hence the present study was conducted with the aim of incorporating chia seeds in fruit punch, kheer, smoothie samples and evaluated with the help of 9 point Hedonic rating scale. Sensory analysis was conducted by 10 trained panel members thrice on sensory attributes such as color, consistency, taste and overall acceptability. Sensory evaluation scores were analyzed using IBM software- SPSS (16). Descriptive and advanced statistics were performed. Within the 3 products, 8 grams sample was best accepted for fruit punch, 4 grams sample for kheer and smoothie sample respectively. Therefore, maximum incorporation of 8 grams of chia seeds in fruit punch, 4 grams of chia seeds in kheer and smoothie was tolerated.

Key words: chia seeds, fruit punch, kheer, smoothie, sensory evaluation.

INTRODUCTION

Chia (*Salvia Hispanica L.*) is an annual herbaceous plant belonging to the Lamiaceae or Labiatae family (Segura-Campos M R et al. 2014). The name *Salvia* originates from the Latin word *Salvare*, meaning 'the healer' (Coorey R et al. 2012). The seed color varies from black, grey, and black spotted to white, and the shape is oval with size ranging from 1 to 2 millimeter. Seeds are consumed in Mexico, Argentina and the southwestern United States (Segura- Campos M R et al. 2014). Owing to the fact that it can grow in arid environments, it has been highly recommended as an alternative crop for the field crop industry.

Chia seed is composed of protein (15–25%), fats (30–33%), carbohydrates (26–41%), dietary fiber (18–30%), and ash (4–5%), it also contains a high amount of vitamins, minerals, dry matter (90–93%) and antioxidants. The seed contains from 25% to 40% oil with 60% of it comprising (omega) ω -3 alpha linolenic acid and 20% of (omega) ω -6 linoleic acid (Ali N M et al. 2012). Chia seeds have been investigated and recommended due to their high levels of proteins, antioxidants, dietary fiber, vitamins, and minerals but particularly due to their oil content with the highest proportion of α -linolenic acid (ω -3) compared to other natural sources known to date (Segura-Campos M R et al. 2014). Chia seeds are high in antioxidants help to protect the delicate fats in the seeds

(Martinez-Cruz O et al. 2014). Chia seeds have high fiber and can absorb up to 10–12 times their weight in water, becoming gel-like and expanding in the stomach carbohydrate thus making chia a low friendly food. (Alfredo V O et al. 2009).

Chia seeds contain a good balance of essential amino acids, so the body should be able to make use of the protein in them (Sandoval- Oliveros M R et al. 2013). Chia seeds are high in quality protein much higher than most plant foods. Protein is the most weight loss friendly macronutrient and can drastically reduce appetite and cravings. Studies have shown that chia seeds (especially if they are milled) can increase blood levels of ALA and EPA, but not DHA which is a problem (Nieman D C et al. 2012; Jin F et al. 2012). In two studies, a diet with chia seeds, soy protein and oats has been shown to lower LDL cholesterol and triglycerides, increase HDL cholesterol and reduce inflammation (Vazquez Manjarrez N et al 2014; Guevara-Cruz M et al 2012). Rat studies have also shown that chia seeds can lower triglycerides, raise HDL (the "good") cholesterol and reduce inflammation, insulin resistance and belly fat (Ayerza R Jr et al. 2007; Chicco AG et al. 2009). However, a study that looked at just chia seeds did not note any improvements (Nieman D C et al. 2012).

In the present study, Chia seeds were selected for its nutritional value particularly omega three fatty acids. India

is a tropical country and climate across most of the cities are humid hence beverages are easily consumed. Also in India, food items are associated with family occasions. Festivals and celebrations are always accompanied with Sweet preparations. Hence for the present study three food products were selected (Fruit Punch, Smoothie and Kheer). This study aimed to incorporate chia seeds in Fruit Punch, Kheer, Smoothie samples; develop an acceptable product and compare their sensory evaluation scores on 9 point Hedonic rating scale.

MATERIALS AND METHODS

The products were innovated in the academic year of 2014-2015 as a research project which was a part of the curriculum in Post Graduation Diploma in Clinical Nutrition and Dietetics, Department of Food and Nutrition, S.V.T. College of Home Science (Autonomous), S.N.D.T. Women's University.

In all the 4 samples of 3 products Fruit punch, kheer, and smoothie were developed as follows

1) Fruit punch

Ingredients:

Watermelon- 100 grams

Pomegranate- 100 grams

Mint leaves- 10 medium size leaves

Water – 50ml

Rock salt- ½ tsp

METHOD OF PREPARATION

Weigh the edible portion of watermelon accurately and keep it aside. Weigh the pomegranate accurately and keep it aside. Wash the leaves thoroughly. Mix all the ingredients together and blend it in the mixer. Strain the juice and add rock salt.

2) Kheer

Ingredients

Milk – 50 ml

Saffron strands- 5-6 strands

Honey- 15 grams

Vermicelli- 8 grams

Method of preparation:

Take milk in a steel vessel. Add the saffron strands to the steel vessel and heat it till the saffron starts emitting colour in the milk. Then add the remaining milk to the same vessel. Add honey to the above mixture. Add vermicelli to the above mixture and let it boil till the vermicelli cooks.

3) Smoothie

Ingredients:

Chickoo- 50 grams

Milk- 125ml

Amul Curd- 25grams

Honey- 10 grams

Method of preparation:

Cut the chickoo into medium size pieces. Remove the seeds. Mix all the ingredients in the mixer and blend it. Do not strain the mixture. Serve chill.

Modifications in the recipes were that the three products (kheer, fruit punch and smoothie) were prepared by using different amounts of chia seeds. Four samples of three

products were developed, 1st sample was standard sample with no incorporation of chia seeds; 2nd, 3rd and 4th samples had 4, 8 and 12 grams of chia seeds respectively.

SENSORY EVALUATION

3 food products were selected i.e. Fruit Punch, Kheer and Smoothie. 10 panel members rated the products thrice on 3 consecutive days. Each of the 4 samples of the 3 products were labeled as code A, code B, code C, code D respectively. However, the amount of chia seeds were shuffled and were not disclosed to the panel members. Grey and white colour chia seeds were used in these products.

The 9-point hedonic scale, also known as degree-of-liking scale, is the most common hedonic scale for measuring product liking by consumers. Differently coded samples are presented to consumer panelists one at a time and they are asked to rate their hedonic response on the scale that can be in a vertical or horizontal line without affecting results. The hedonic scale is based on equal interval, which is important in the assignment of numerical values to the response choices (from 1 = “dislike extremely” to 9 = “like extremely”) (<http://www.gustosalutequalita.it/en/hot-topics-gsq/consumer-science/affective-tests/acceptance-tests/hedonic-scale>).

Sensory analysis was carried out for the following attributes:

- a) Colour
- b) Consistency
- c) Taste
- d) Overall acceptability

The above attributes were rated on a 9 point Hedonic scale indicating the following scores:

- 9 - Like extremely
- 8 – Like very much
- 7 – Like moderately
- 6 – Like slightly
- 5 – Neither like or dislike
- 4 –Dislike slightly
- 3 – Dislike moderately
- 2 – Dislike very much
- 1 – Dislike extremely

SENSORY EVALUATION ANALYSIS

Sensory evaluation scores were analyzed using IBM software - SPSS(16). Descriptive and advanced statistics were performed where $p < 0.05$ was considered to be statistically significant. Paired sample z test was used to compare 4 samples of each product.

RESULTS AND DISCUSSION

Sensory analysis was done 10 panel members and they evaluated 3 products with 4 samples each. The panel members were asked to rate the products on basis of 9 point Hedonic rating scale. The products were evaluated for attributes such as colour, consistency, taste and overall acceptability. Table 1 describes Sensory Evaluation Scores and significance levels for colour, consistency, taste and overall acceptability attributes of fruit punch, kheer and smoothie samples.

Table 1: Sensory Evaluation Scores and significance levels for colour, consistency, taste and overall acceptability attributes of Fruit Punch, Kheer and Smoothie samples

Sensory attributes								
Colour			Consistency		Taste		Overall acceptability	
FRUIT PUNCH								
Sr. No	Mean \pm SD	p value	Mean \pm SD	p value	Mean \pm SD	p value	Mean \pm SD	P value
S1	6.93 \pm 0.82	6.83 \pm 0.87	6.70 \pm 0.95	6.92 \pm 1.13				
S2	7.10 \pm 0.88	0.231	6.73 \pm 1.36	0.712	6.37 \pm 1.58	0.277	6.65 \pm 1.53	0.242
S3	7.10 \pm 1.18	0.433	6.80 \pm 1.42	0.908	6.63 \pm 1.58	0.810	6.55 \pm 1.42	0.150
S4	6.63 \pm 1.35	0.279	5.73 \pm 1.66	0.005	5.90 \pm 1.86	0.033	5.97 \pm 1.83	0.0005
KHEER								
Sr. No	Mean \pm SD	p value	Mean \pm SD	p value	Mean \pm SD	p value	Mean \pm SD	p value
S1	7.57 \pm 0.97	6.83 \pm 1.23	7.40 \pm 1.07	7.48 \pm 0.98				
S2	7.23 \pm 1.13	0.115	7.07 \pm 1.11	0.394	7.43 \pm 1.10	0.823	7.18 \pm 1.28	0.224
S3	6.67 \pm 1.58	0.015	6.23 \pm 1.85	0.161	6.30 \pm 1.91	0.011	6.38 \pm 1.75	0.005
S4	5.83 \pm 1.78	0.000	5.27 \pm 1.72	0.001	5.87 \pm 1.65	0.000	5.56 \pm 1.57	0.000
SMOOTHIE								
Sr. No	Mean \pm SD	p value	Mean \pm SD	p value	Mean \pm SD	p value	Mean \pm SD	p value
S1	7.47 \pm 0.97	7.33 \pm 0.84	7.43 \pm 0.89	7.41 \pm 0.89				
S2	7.43 \pm 0.89	0.801	7.17 \pm 0.79	0.305	7.40 \pm 0.89	0.831	7.31 \pm 0.95	0.501
S3	7.13 \pm 0.97	0.086	6.27 \pm 1.25	0.001	6.80 \pm 1.40	0.047	6.55 \pm 1.28	0.002
S4	6.47 \pm 1.67	0.006	5.40 \pm 1.88	0.000	6.03 \pm 1.60	0.000	5.97 \pm 1.71	0.000

FRUIT PUNCH

COLOUR

In comparison with the standard fruit punch i.e. S1 the mean colour score increased by 0.17 for both S2 as well for S3 and for S4 it reduced by 0.3, however these differences were non significant. There was no difference in the scores of S2 and S3. The best mean score reported was for S2 and S3 and above 8 grams the score reduced significantly. The best mean score was shared by S2 and S3 followed by S4 respectively. Maximum incorporation of chia seeds tolerated was upto 8 grams.

CONSISTENCY

S1 when compared with S2 and S3, the mean score slightly reduced by 0.10 and 0.03 respectively. Mean score reported for S3 was greater than S2. However, these changes were not significant. Attributing to the fact that chia seeds incorporation was accepted till 8 grams. For S4, mean score reduced by 1.10 and this change was highly significant ($z=3.056$, $p<0.01$). Thus maximum incorporation of chia seeds was accepted for S3 and above 8 grams there was highly significant decline in scores

TASTE

On Comparison of S1 with S2, S3 and S4, the mean score decreased by 0.33, 0.07 and 0.8 respectively, and only the reduction in scores for S4 was significant ($z=2.242$, $p<0.05$) as increase in the amount of chia seeds lead to a change in the mouth feel of the product. There was no significant difference in the scores of S2 and S3. The best taste acceptance was S1 followed by S3 (8 grams) respectively; after which the scores dropped significantly.

OVERALL ACCEPTABILITY

In comparison with the standard fruit punch i.e. S1 the mean score decreased by 0.27 and 0.37 for S2 and S3, for S4 it reduced by 0.95, and was highly significant ($z=3.054$, $p<0.01$). There was no difference in the scores of S2 and S3. The best mean score obtained was for S1, followed by S2. Chia seeds incorporation was well tolerated till S3 (8 grams) and then scores reduced significantly.

KHEER

COLOUR

In comparison with the standard Kheer i.e. S1 the mean colour score decreased by 0.34, 0.9 and 1.74 for S2, S3 and S4 respectively. This reduction in score was significant for S3 ($z=2.594$, $p<0.05$) and highly significant for S4 ($z=4.557$, $p<0.01$). There was significant difference between the scores of S2 and S3. The best mean score was for S1 followed by S2. Above 4 grams the score reduced significantly as increase in the amount of chia seeds lead to a different mouth feel than other samples.

CONSISTENCY

S1 when compared with S2 and S3 the mean score increased by 0.24 and decreased by 0.6 respectively, however these changes were non significant. Mean score of S4 when compared to S1 reduced by 1.56 and was highly significant ($z=3.859$, $p<0.01$). The product was well tolerated till S3 (8 grams) and then the scores reduced significantly.

TASTE

On Comparison with S1, the mean score increased slightly by 0.03 for S2 and decreased by 1.1 for S3 respectively and changes were not significant. Mean score of S4 reduced by 1.53 when compared with S1 and was highly significant ($z=4.323$, $p<0.01$). The best taste acceptance was for S2 (4 grams), then the scores reduced significantly.

OVERALL ACCEPTABILITY

In comparison with the standard kheer, the mean score decreased by 0.3 for S2 and was non significant. For S3, S4 it reduced by 1.18, 1.92 and were highly significant ($z=3.063$, $p<0.01$) ($z=5.464$, $p<0.01$). The best mean score was for S1, followed by S2 and above 4 grams the score reduced significantly.

SMOOTHIE

COLOUR

In comparison with standard sample i.e. S1, the mean colour score decreased by 0.04, 0.34 and 1.00 for S2, S3 and S4 respectively. However reduction for S2 was non significant, for S3 was significant ($z=1.775$, $p<0.05$) and for S4 was highly significant ($z=2.956$, $p<0.01$). The best mean score was for S1 and after chia seeds incorporation was for S2 and above 4 grams the scores reduced significantly.

CONSISTENCY

S1 when compared with S2, S3 and S4, the mean score reduced by 0.16, 1.06 and 1.93 respectively. However the drop in score was non significant for S2, highly significant for S3 ($z=1.686$, $p<0.01$) and S4 ($z=4.822$, $p<0.01$). Mean score reported for S3 was greater than S4. Thus best mean score was for S1 followed by S2 (4 grams) and above 4 grams there was highly significant decline in scores.

TASTE

On Comparison S1 with S2, S3 and S4, the mean score decreased by 0.03, 0.63 and 1.4 respectively, the reduction in scores for S3 was significant ($z=2.076$, $p<0.05$) and S4 was highly significant ($z=4.324$, $p<0.01$). The best taste acceptance score was for S1 followed by S2 and above 4 grams, incorporation of chia seeds the scores reduced significantly.

OVERALL ACCEPTABILITY

In comparison with S1, the mean score decreased by 0.1, 0.86 and 1.44 for S2, S3, S4 respectively and for latter two samples the reductions were highly significant ($z=3.329$, $p<0.01$) ($z=4.479$, $p<0.01$). The best mean score was for S1 followed by S2 and beyond 4 grams the scores reduced significantly.

The overall best sample after incorporation of chia seeds for each of the three products developed was determined with the help of best mean score and also the best three samples were compared for the overall best product. "Figure 1" describes the sensory evaluation scores

for colour, consistency, taste and overall acceptability of fruit punch, kheer and smoothie samples.

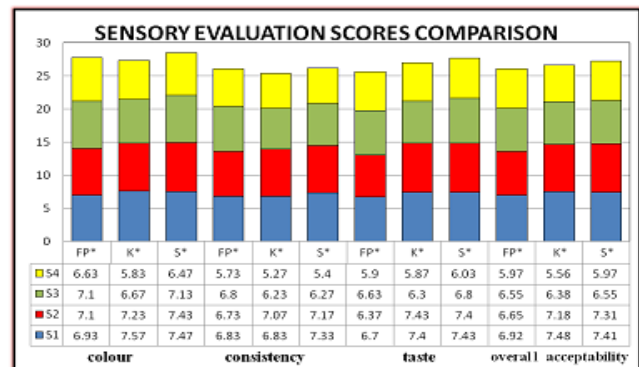


Figure 1: Sensory evaluation scores for colour, consistency, taste and overall acceptability of fruit punch, kheer and smoothie samples.

*FP= Fruit punch, K= Kheer, S= Smoothie

WITHIN THE PRODUCTS

"Figure 1" describes the sensory evaluation scores for colour, consistency, taste and overall acceptability of fruit punch, kheer and smoothie samples. After the chia seeds incorporation, Fruit Punch mean colour score was best accepted for S3, consistency for S2, taste for S3. However, overall acceptance of the product was for S2. In kheer samples, colour, consistency, taste and overall acceptability was favourable for S2. Similarly for smoothie samples, the best accepted amount was for S2 for all the four attributes. Therefore, S3 sample was best accepted for fruit punch, S2 sample for kheer and smoothie sample respectively.

In a study, the hydrogenated vegetable fat content was reduced when chia seeds or flour were added to the formulations of wheat flour bread based on a 2² central composite rotational design generating the two products: bread with 7.8 g/100 g chia flour and 0.9 g/100 g fat and bread with 11.0 g/100 g chia seeds and 1.0 g/100 g fat, resulting in a reduction of 27% and 24%, respectively, in the level of saturated fat compared to that of bread prepared with wheat flour. The ratio of polyunsaturated and saturated fats (PUFA: SAT) which was 1.01 in the control bread was increased to 3.1 and 3.9 respectively, using chia flour and seeds. The content of fiber and ω -3 fatty acid was increased in the final products. These new formulations might be used on an industrial scale to prepare products that could contribute to reducing the intake of saturated fatty acids and increasing that of essential fatty acids, such as ω -3 fatty acid. (Coelho M S et al. 2014; Nazni and Pradeepa, 2010)

Composite flours containing 5%, 10%, 15%, and 20% of chia seed flour and corn were used for tortilla formulations. The effects of chia powders supplementation on the physicochemical and sensorial characteristics as well as starch digestibility of the tortillas were evaluated. Nutritionally, all chia tortillas had significantly higher levels ($P<0.001$) of protein, lipids, and total dietary fibre than the control. The reduced enzymatic starch hydrolysis rate and predicted glycemic index recorded for the chia

seed-added tortilla indicated slow digestion features. Sensory evaluation did not show significant ($P>0.05$) differences in the attributes among tortillas. Owing to the increase in the total dietary fibre, lower digestion, and predicted glycemic index values, chia seed-added tortilla can be considered as a nutraceutical food. Therefore, the newly developed tortilla supplemented with chia seed flour could represent a valuable staple in improving the nutritional value of the original food product. (Rendón-Villalobos R et al. 2012)

In a study, development of hamburger meat product aimed at harnessing meat of old sheep of little acceptance in nature with pork and chia seed was studied. The better acceptance formulation was used to prepare three formulations the relationship being of sheep/pork of 50/50 (w/w) and chia seed concentrations of 0%, 2% and 4%. The results showed significant difference ($P<0.05$) acceptability among FA formulations (without chia seed) and FC (4% chia seed) at 120 days and between FC formulation at 90 and 120 days. The chemical composition was significantly affected by the addition of chia seed. The cooking weight loss was ranging from 11.6% (FC) to 19.29% (FA). In the evaluation of thiobarbituric acid reactive substances (TBARS) and ischemic Peroxidation (IP) it was verified interference in the formulations by the addition of chia seed. The use of chia seed these burgers can be recommended up to 4%. (Melo J M et al. 2014)

BETWEEN THE PRODUCTS

S3 of fruit punch, S2 of kheer and S2 of smoothie were compared to identify the overall best product. The best mean score for taste attribute after incorporation of chia seeds was attained for kheer S2. For colour, consistency and overall acceptability, the best mean score was obtained for smoothie S2. However, the mean score for taste attribute increased after incorporation of chia seeds when compared with standard sample, but the mean score decreased for colour, consistency and overall acceptability when compared to standard sample. Beyond these amount, the score reduced significantly when compared with standard ($p>0.05$).

To develop new cereal-based products with increased nutritional quality by using chia and ground chia seeds (whole chia flour, semi-defatted chia flour and low-fat chia flour) in order to evaluate its potential as a bread-making ingredient was investigated in this study. The samples with chia addition significantly increased the levels of proteins, lipids, ash and dietary fibre in the final product compared to the control sample. Breads with seeds or ground seeds showed similar technological quality to the control bread, except for the increase in specific bread volume, decrease in crumb firmness and change in crumb colour. Sensory analysis showed that the inclusion of chia increased overall acceptability by consumers. The thermal properties of the starch did not alter substantially with the inclusion of chia. However, the incorporation of chia inhibited the kinetics of amylopectin retrogradation during storage which would be directly related to the delay in bread staling. (Iglesias-Puig E et al. 2013)

The objective of this study was to analyze the influence of chia seeds and flour on the organoleptic quality of gluten-free breads. Rice breads were elaborated with the addition of 15 g of chia flour or seed, either dry or pre-hydrated, per 100 g of rice flour. The influence of the addition of chia on flour pasting properties and dough proofing behavior was analyzed. The specific volume, weight, texture, color and acceptability of the breads were studied. The addition of chia reduced specific volume and increased the hardness of breads and the effect was more evident with the flour than with seed. Chia addition minimized weight loss during baking in all cases. The addition of chia flour produced a darker crust and crumb. There were no significant differences between the different breads in the global acceptability, but chia seed breads presented better values in terms of texture than control. This study shows that the use of chia seed and flours in rice bread making allows results in breads with good acceptability. However, the correct selection of seed or flours and previous hydration or not are essential to achieve appropriate results. Thereby, breads with chia seeds showed a better aspect valued by consumers, a higher specific volume and a lower firmness than breads made with chia flour without a quality improvement in the case of a previous prehydration. (Steffolani E et al. 2014).

The purpose of this study was to investigate the effects of adding whole chia flour (WCF) on the technological, nutritional and sensory qualities of cakes. Different contents of WCF (0-30 g/100 g flour mixture) and hydrogenated vegetable fat (HVF) (12- 20 g/100 g flour mixture) were added to the cake mix based on a 2^2 central composite rotational design. Subsequently, the cake with the best technological results was selected and both the selected cake and the control cake (without WCF) were evaluated for their nutritional and sensory qualities. The results showed that addition of WCF decreased the specific volume and colour parameters of the cakes. The variation in WCF and HVF contents contributed to maintenance of the moisture content during storage. The best technological results were obtained with cakes containing up to 15 g WCF/100 g flour mixture and from 16 to 20 g HVF/100 g flour mixture. The cake formulations containing 15 g WCF/100 g flour mixture and 20 g HVF/100 g flour mixture were selected for further evaluations, and presented higher protein, lipid and ash contents than the control cake. This formulation also exhibited a considerable increase in its omega-3 fatty acid content, good sensory acceptance and a greater purchasing intention (Pizarro P L et al. 2012; Parameshwari and Nazni, 2012).

The objective of this research was to develop a high protein, high dietary fibre, gluten free and omega-3 fatty acid rich chips. Four different levels of whole chia flour (5%, 10%, 12%, and 15%) were incorporated to produce chia chip. There were no significant differences in appearance, colour, flavor and overall liking between a commercial chip sample and the 5% chia chips. The chemical analysis indicated that all four trial chips are excellent sources of omega-3 and the baking process has a limited impact on their nutritional profile. For optimal

consumer acceptance and nutritional benefits, the incorporation of 5% chia is recommended. With limited chia based food products currently available, a chia chip would be a well-accepted and healthy alternative to the common unhealthy chips. (Coorey R et al. 2012).

Many studies were conducted incorporating chia seeds in different forms and in different products. Their acceptable amount differed. Hence the present study evaluated an acceptable amount of chia seeds that could be included in fruit punch, kheer and smoothie.

LIMITATION

As very few studies are conducted with similar objective of incorporation of Chia seeds in beverages and developing an acceptable product, proper conclusions could not be drawn in terms of comparison.

APPLICATIONS

As India is a tropical region, the weather is always hot and humid. So a beverage is ideal when people are thirsty. So addition of chia seeds in beverages will not change the taste of the product but also will be enriched with omega 3 and fiber. That is why this present study was carried on. All age groups can benefit from chia seeds. When introducing complementary feeding to child, chia kheer can be given, for adults fruit punch can be served during gathering, conferences also for athletes as a health drink and for senior citizens, cachexic patients chia smoothie can be given.

CONCLUSION

However, the mean overall acceptability score for all the three best products was less when compared with the standard sample. But this reduction in score was non significant ($p > 0.05$). Therefore, maximum incorporation of 8 grams of chia seeds in fruit punch, 4 grams of chia seeds in kheer and smoothie was well tolerated.

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