



**ORIGINAL RESEARCH PAPER**

**Science**

**FORMULATION, STANDARDISATION AND PROXIMATE COMPOSITION OF MILLETS AND CHIA SEEDS (*Salvia hispanica* L.) BASED RECIPES**

**KEY WORDS:** Chia seeds, functional food, satiety index, omega-3 fatty acid

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**ABSTRACT**

**Introduction:** Chia seed is an ancient oilseed used by Mayas and Aztecs as a food stuff. Chia can be considered as "functional food" because apart from contributing to human nutrition chia helps to increase satiety index, prevent cardiovascular diseases, inflammatory and nervous system disorders, and diabetes. Millets are not only comparable to major cereals with respect to their nutritional features but are very good sources of carbohydrates, micronutrients and phytochemicals with nutraceutical properties **Methods:** The recipes namely Chia seed millet balls, Chia seed cookies, Chia peppermint drink, Chia chikki balls and Chia smoothie were formulated, organoleptically evaluated and nutritive value was assessed. **Findings:** The sensory scores revealed that Chia formulated recipes had higher mean score and was acceptable. The nutritive value of Chia recipes had a considerable increase in all the nutrients. **Conclusion:** Chia seeds proved to be an effective ingredient in the food products to be consumed by the public. The essential nutrients like omega-3 present in Chia have a great impact in the health of an individual and also would help the vegetarians to use Chia seeds as a source of omega-3 fatty acids.

**INTRODUCTION**

Chia (*Salvia hispanica* L.) is a tiny edible seed that comes from an annual herbaceous plant which is highly valued for their nutritional properties and medicinal value. It contains healthy omega – 3 fatty acids, polyunsaturated fatty acids, dietary fibre, and protein including all essential amino acids, vitamins, calcium, and other important minerals. It is also a rich source of polyphenols and antioxidants (Ranjana Deka and Akan Das, 2017). Chia seeds which are tasteless can be incorporated into foods in different forms. The products made with chia seeds were baked foods such as cookies, crackers, muffins, cakes and breads where Chia can be used as a substitute for eggs. The other products like pudding, jam, fruit juices, smoothies, protein balls, porridges, milk shake etc. Chia seeds can also be incorporated into *dosa*, salads, soups, savories and snacks. Millets are not only comparable to major cereals with respect to their nutritional features but are very good sources of carbohydrates, micronutrients and phytochemicals with nutraceutical properties (Dayakar Rao, et al., 2017).

**MATERIALS AND METHODS**

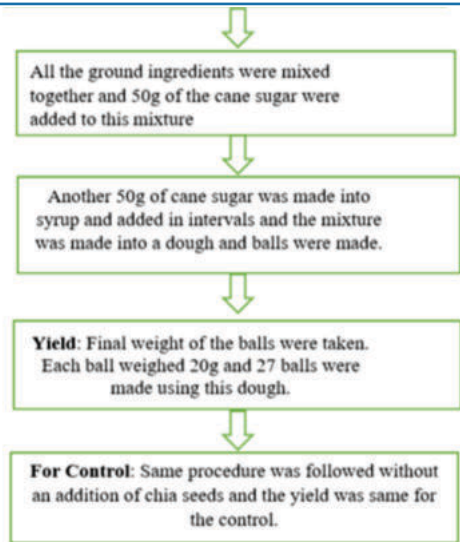
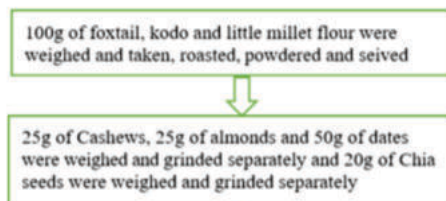
**Selection of Recipes**

Five common recipes were selected based on convenience of incorporating the chia seed. The selected recipes are Chia seed millet balls, Chia seed cookies, Chia peppermint drink, Chia chikki balls, Chia smoothie.

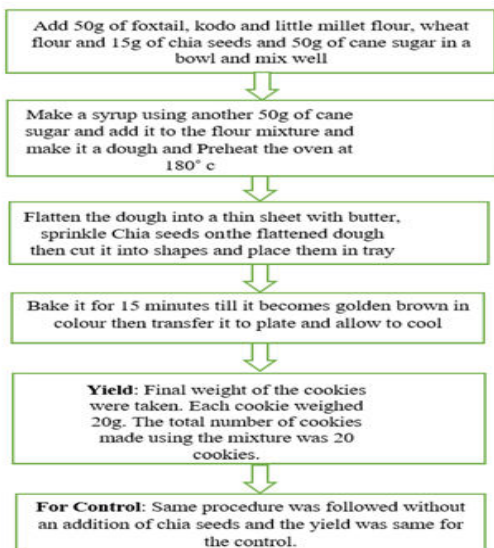
**Procurement Of Ingredients For The Selected Recipes**

The Chia seed was obtained from a super market in Coimbatore. The other raw materials needed for the recipe preparation like millets, cane sugar was procured from a local organic store in Coimbatore. The Fruits used for other recipes like lemon, papaya and banana were purchased from fruit shop in Coimbatore on the day before preparation of the recipes.

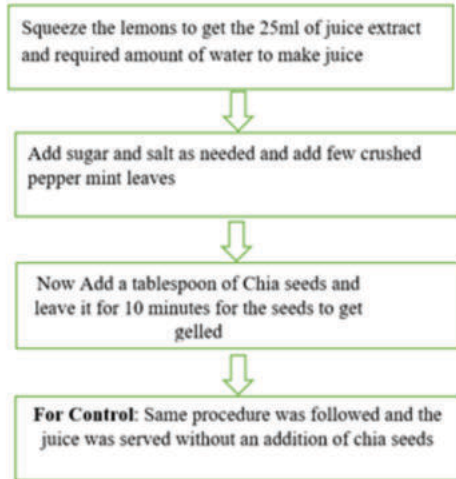
**Formulation Of Recipes**



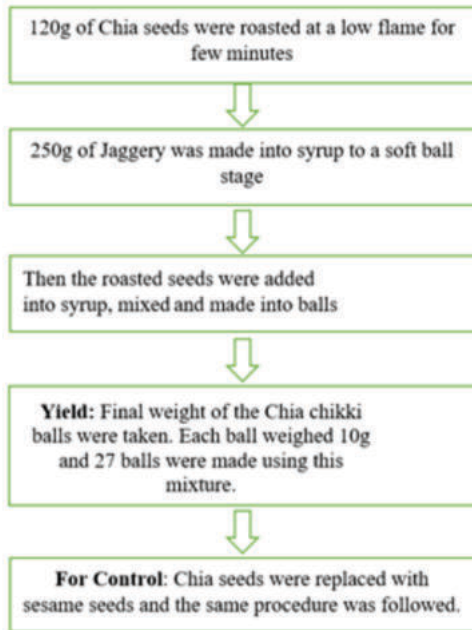
Chia Millet Ball & Control **Figure 1**



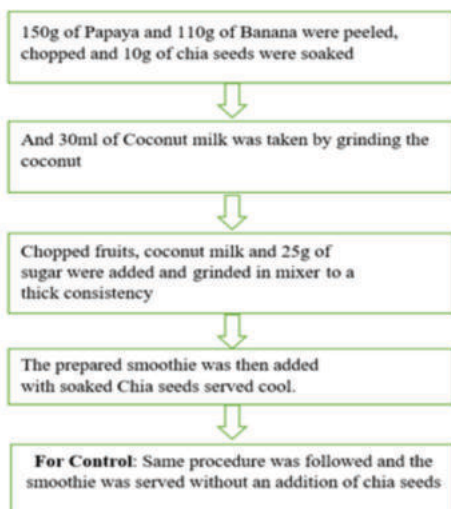
Chia Cookies & Control **Figure 2**



Chia Peppermint Drink & Control **Figure 3**



Chia Chikki Balls & Control **Figure 4**



Chia Smoothie were formulated & Control **Figure 5**

**Standardization of Recipes**

The formulated recipes were standardized in order to make it desirable in terms of taste, flavour and acceptability. The Chia seeds and millets were added accordingly. For all the five recipes a control was prepared without addition of Chia seeds and were organoleptically evaluated.

**Organoleptic Evaluation of Recipes**

Sensory evaluation of the prepared recipes was done by a panel consisting of twenty-five members using four-point hedonic scale. Each panellist was given a score card and asked to evaluate the samples for different attributes viz. fragrance, aroma, flavour, strength, taste, and overall acceptability for both control and sample.

**Nutritive Value of the Formulated Recipes**

The nutrient content of the developed products were calculated using the Indian Food Composition Tables (2017) and Nutritive value of Indian Foods (2010) with reference to energy, protein, carbohydrate, fat, fiber, iron, calcium, magnesium, phosphorus. The nutritive value was calculated for the whole weight of the prepared products and also calculated for per serving.

**RESULTS & DISCUSSION**

**1. Acceptability of the Formulated Food Items**

The mean sensory scores of all the five recipes were tabulated in the following tables

**a. Comparison of Organoleptic Qualities of Control and Chia Millet Balls**

**Table 1**

Criteria	Control millet Balls	Chia millet balls
Colour	3.12±0.6	2.96±0.54
Flavour	3.28±0.46	3.56±0.65
Taste	3.12±0.52	3.44±0.65
Appearance	3.44±0.51	3.56±0.51
Texture	3.96±0.2	3.88±0.33
Overall acceptability	3.48±0.51	3.72±0.46

Table 1 clearly depicts that the overall acceptability of the Chia millet balls was high of about 3.72±0.46 when compared to the control millet balls with the value of 3.48±0.51. The colour of the Chia balls were scored least when compared to control millet balls as the Chia balls were darker in colour than the control millet balls.

**b. Comparison of Organoleptic Qualities of Control and Chia Millet Cookies**

**Table 2**

Criteria	Control millet cookies	Chia millet cookies
Colour	3.84±0.37	3.68±0.56
Flavour	3.72±0.46	3.6±0.5
Taste	3.4±0.5	3.4±0.5
Appearance	3.8±0.41	3.64±0.49
Texture	3.68±0.48	2.92±0.86
Overall acceptability	3.8±0.41	3.4±0.5

From the table 2 it is clear seen that the Chia cookies had a less score for colour, flavour and appearance. The texture of Chia seeds is less of about 2.92±0.86 when compared to control as these seed have gelling properties which when added in the dough prepared for cookie results in slight swelling of the seeds. The Chia gel formed affects the texture of the cookies.

The taste of both the cookies were same. The overall acceptability of the Chia cookies was less with 3.4±0.5 score when compared to Control cookies with the score of 3.8±0.41.

**c. Comparison of Organoleptic Qualities of Control and**

**Chia Peppermint Drink**

**Table 3**

Criteria	Control peppermint drink	Chia peppermint drink
Colour	3.64±0.49	3.64±0.57
Flavour	3.6±0.57	3.64±0.49
Taste	3.08±0.64	3.44±0.65
Appearance	3.44±0.58	3.56±0.51
Consistency	3.6±0.57	3.64±0.49
Overall acceptability	3.48±0.51	3.68±0.48

From Table 3 it is clear that the Chia drink gained high scores than the control drink in all the attributes of the sensory evaluation. The chia seeds when added to water swell and become gel. The taste of chia drink has a score of 3.44±0.65 higher than the control lime drink. The appearance of the Chia drink scored high of about 3.56±0.51 as gelled chia seeds were more attractive and appealing than the control drink without chia seeds. The color and flavor of both the drinks were on par. The overall acceptability of the chia drink with the score of 3.68±0.48 which is more acceptable than the control drink without chia seeds.

**d. Comparison of Organoleptic Qualities of Control and Chia Chikki Balls**

**Table 4**

Criteria	Control balls	Chia chikki balls
Colour	3.64±0.64	3.48±0.58
Flavour	3.08±0.95	3.52±0.65
Taste	2.68±0.99	3.52±0.65
Appearance	3.36±0.81	3.44±0.77
Texture	2.68±0.85	3.56±0.71
Overall acceptability	2.92±0.76	3.56±0.65

From the table 4 it is clearly understood that the chikki balls made with chia had a good score than the control balls. The colour of the control balls scored high as chia balls were very lighter in colour and scored 3.48±0.58. The taste of the chia chikki balls were good compared to the control balls. The texture of the control balls were very hard which scored less of about 2.68±0.85 than the chia chikki balls which scored 3.56±0.71 because of its gelling ability Chia balls had a good texture. The overall acceptability of the Chia chikki balls was higher with 3.56±0.65 and it is obvious that it is highly acceptable.

**e. Comparison of Organoleptic Qualities of Control and Chia Smoothie**

**Table 5**

Criteria	Control smoothie	Chia smoothie
Colour	3.96±0.2	3.96±0.2
Flavour	3.52±0.51	3.52±0.51
Taste	3.56±0.58	3.4±0.64
Appearance	3.8±0.41	3.8±0.41
Consistency	3.92±0.28	3.84±0.37
Overall acceptability	3.72±0.46	3.72±0.46

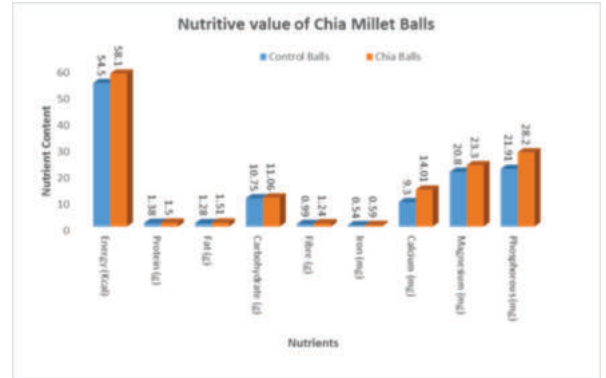
Table 5 depicts that there was no greater variation in the mean values obtained for the smoothie. The colour, flavour, appearance were same for both the smoothies. The taste of the Chia seed smoothie scored less as when the seeds were added into the liquid it forms a gel and therefore it gives a different taste. The consistency of the Chia smoothie was affected as the gelled seeds make the smoothie thicker than the control smoothie. The overall acceptability of the smoothie were same with the mean score of 3.72±0.46 indicating the acceptability of the Chia seed smoothie.

**Nutritive value of recipes**

The nutritive value of the formulated recipes were calculated using Indian Food Composition tables (2017) and Nutritive

value Indian Foods (2010).

**a. Nutritive Value of Control and Chia Millet Balls**



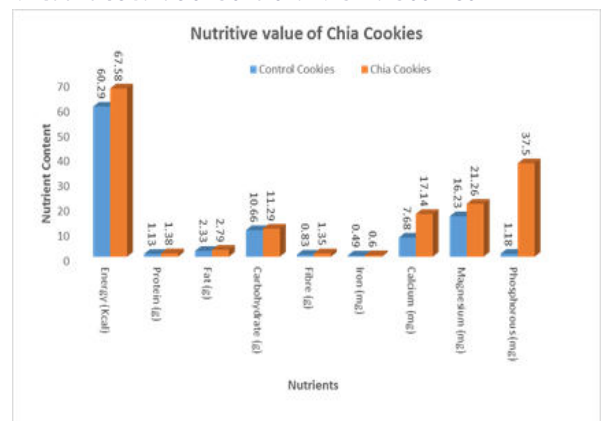
**Figure 6**

The Nutritive value of the millet balls calculated revealed that the Chia seeds added balls had a greater content when compared to control. The calcium content increased from 9.3mg of control balls to 14.01mg in Chia seed added millet balls. The other minerals like magnesium and phosphorous content were increased by 0.12% and 0.29% respectively.

The protein content of the Chia seed balls were increased by 0.09% that is from the control millet balls content of 1.38 g to 1.50g when Chia seeds were added to it. This makes the millet balls enriched with additional protein.

The fiber content of the millet balls added with chia seeds were 1.24g where 0.25% increase was seen. Therefore the Chia millet balls had additional nutrient content in it compared to the control millet balls.

**b. Nutritive Value of Control and Chia Cookies**



**Figure 7**

The fat content of the Chia cookies were increased by 0.20% which was similar to the report of Coelho *et al.* (2015) stated that the content of fiber and ω-3 fatty acid was increased in the final products with Chia which 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.

The fiber content was found to be high in Chia cookies with 1.35g than the control cookies which has 0.83g. George, *et al.* (2014) elucidated that fibre content and omega-3 enriched cookies proved to be very beneficial if used commercially.

The Chia cookies also had a greater increase in the mineral content like Calcium, Magnesium, and Phosphorous of 17.14mg, 21.26mg, and 37.5mg respectively.

**c. Nutritive Value of Control and Chia Peppermint Drink**

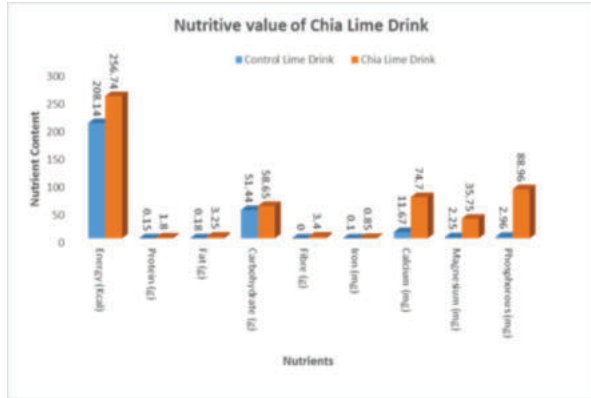


Figure 8

The table 8 shows a greater increase in the nutrient content of the Chia lime drink. The fiber content which is absent in the control drink is present about 3.4g in the Chia lime drink. Chia seeds could therefore also be used for the gut health because soluble fiber prolongs the gastro- intestinal transit time that aids in improved digestion. (Sukhneet suri *et al.*, 2016).

The fat content of the drink was increased by 17% which is of essential fatty acids and good for the body. The carbohydrate content was increased by 0.14%. Chia seeds are a good alternative to carbohydrate loading in athletes where sugar intake is reduced by increasing omega-3 fatty acids. Illian *et al.* (2011) in a study reported that 50% of carbohydrate was replaced with Chia seeds.

The Chia lime drink also had good amount of protein, Calcium, Magnesium and Phosphorus.

**d. Nutritive Value of Control and Chia Chikki Balls**

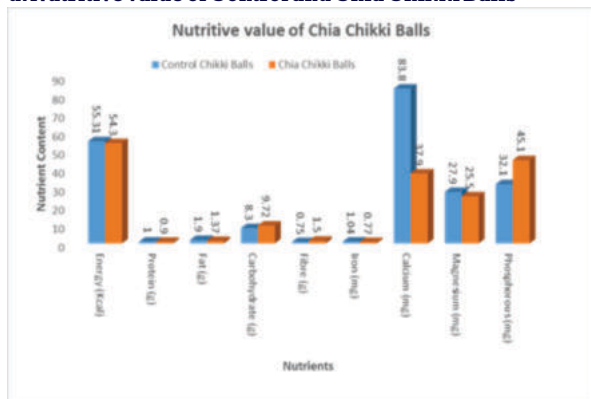


Figure 9

The table 9 shows a highest nutrient content for the control balls than the Chia chikki balls. The control balls has more content of Energy, Protein, Fat, Iron and calcium of about 0.02%, 0.1%, 0.28%, 0.26% and 0.55% respectively. This shows that the control balls has good amount of nutrients in it because control balls were made using sesame seeds which is nutritionally high.

The Chia chikki balls have a fiber content of 1.5g indicating a fiber rich product. The carbohydrate content was found to be more of about 9.72g. Hence on comparison the table depicts a decrease in some of the nutrient content of chia chikki balls.

**E. Nutritive Value Of Control And Chia Smoothie**

The table 10 shows an increase in the nutrient content of the Chia smoothie. It represents a considerable amount of nutrients like protein 4.80g, fat 16.07g, fiber 12.8g and iron 1.81g.

The mineral content of Chia smoothie is higher compared to

the control smoothie with an increase in the nutrient content of 1.8% calcium, 0.40% magnesium and 1.2% phosphorus. Therefore it is obvious that Chia adds beneficial nutrients to the recipe.

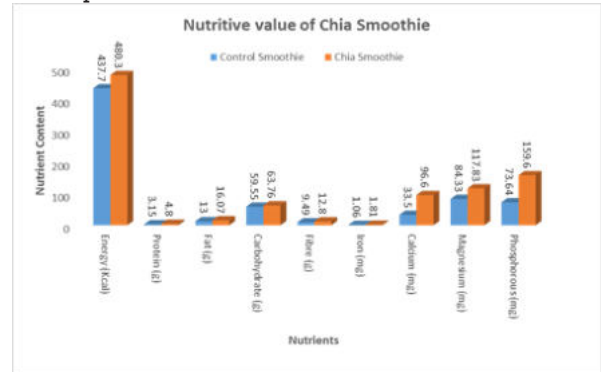


Figure 10

**CONCLUSION**

From the study it is clearly understood that the Chia seed acts as healthy ingredient in the diet and it can be added to any kind of foods since it does not affect the taste of the food. The Chia seeds increase the nutritional value of the foods and hence could be a part of a healthy diet and improves the health greatly.

**RECOMMENDATIONS**

- Bioavailability of Chia seeds need to be studied.
- More recipes can be formulated using Chia seeds and its health benefits could be studied.

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