

Incorporation of Chia Seeds In Biscuits And Smoothie

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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. Aim of the study was to conduct a Consumer awareness survey, Market survey and to develop Recipes using Chia Seeds. Consumer awareness survey concluded that 64% of the consumers out of 100% were unaware of Chia seeds. Hence, to create awareness Nutrition education material (Brochure) was formulated and distributed and the Market survey was conducted for availability of chia seeds which concluded that 8 super markets out of 20, 10 general stores and 15 dawasaz stores out of 15 contains Chia Seeds in Hyderabad. As Chia seed is not frequently consumed in India, hence the present study was conducted with the aim of incorporating chia seeds in Multigrain Biscuits and Smoothie which was evaluated with the help of 5 point Hedonic rating scale and it was conducted by 25 panelists twice on sensory attributes. Within the 2 products, 5 grams sample was best accepted for Multigrain biscuits and 10 grams for smoothie respectively. Therefore, maximum incorporation of 5 grams of chia seeds in Multigrain Biscuits, and 10 grams in smoothie was accepted. Nutrient analysis was done for estimating Fibre and Protein content of basic and best variation of Chia Apple Smoothie (i.e. Fibre-1.25 to 5.58 and 9.9 to 10.7) and Multigrain chia biscuit (i.e. Fibre-1.9 to 3.2 and Protein -13.4 to 16.3) and the result stated that the Addition of Chia seed has improved the Fibre and the Protein content of the recipes. Hence the study suggests the effect of incorporation of chia seed powder develops Nutritious Biscuits and Smoothie.

Keywords- Chia Seeds, Consumer Awareness Survey, Market Survey, Chia Apple Smoothie, Multigrain Chia Biscuits, Fibre, Protein.

I. INTRODUCTION

Salvia hispanica L., a biannually cultivated plant, is categorized under the mint family (Labiatae), superdivision of Spermatophyta, and kingdom of Plantae. Salvia hispanica is Commonly grown for its seeds and also produces white or purple flowers. The seed color varies from black, grey, and black spotted to white, and the shape is oval with size ranging from 1 to 2 mm. Wild and domesticated chia differs little. Currently, Salvia Hispanica is the only species of genus Salvia that can be grown domestically.

Chia seed is composed of protein, fats, carbohydrates, high dietary fiber, ash, minerals, vitamins, and dry matter. It also contains a high amount of antioxidants. Heavy metal analysis have shown that chia seed contains them at safe levels, not exceeding the maximum metal levels for food safety, and the seed is also free from mycotoxins. Another key feature of chia seed is that it does not contain gluten. Chia Seeds are rich in both essential fatty acids that are required by the human body for good health, and they cannot be artificially synthesized.^[16]

1. PROXIMATE CONTENT OF CHIA SEEDS

Nutrients (100gms)	Chia seed (%)
Protein	21.52
Carbohydrates	40.89
Fat	24.83
Soluble fiber	-
Omega -3, fatty acids	17.32
Insoluble fiber	49.47
Energy (Kcal)	473.11

Chia seed contain higher amount of protein (21.5%) when compared to other food items, wheat (11.8%), Oats (13%), Barley (11.5%), rice (6.8%), and corn (11%). The average protein content varies from 15 to 23% .According to the location when the seeds have grown. The Total fat content of chia seed was 24.8% off which 17.3% contains omega-3 fatty acids. Omega – 3 fatty acids are helpful in the prevention and management of hyperlipidemia, hyperglycemia and hypertension. The Insoluble dietary fibre of chia seeds ranges between 23 to 50% .In the present study, the insoluble dietary fibre content of chia seed has nearly 49.5% which is capable of retaining water several times of its weight during hydration and thus provides bulk and prolongs the gastro intestinal transit time. Increased gastro intestinal time is directly related to gradual increase in post-prandial glucose levels and decrease in insulin resistance over a period of time^[4]

2. HEALTH BENEFITS OF CHIA SEEDS

- **CARDIO-PROTECTIVE EFFECTS:** Alpha-linolenic acid, eicosapentaenoic acids play a vital role in the formation of vital biochemical compounds such as prostaglandins, leukotrienes, and thromboxanes which are encountered in numerous physiological functions.

Omega-3 fatty has the capability of blocking calcium and sodium channel dysfunctions, which otherwise can consequences in hypertension^[18]. Omega-3 fatty acids improve the parasympathetic tone, heart rate variability and protect ventricular arrhythmia. Fatty acid composition of chia has been reported in literature^[17].

- **EFFECT OF CHIA ON IMMUNE SYSTEM:** The effect of chia seed on the immune system of 23 days old Weanling male Wistar rats, the concentrations of thymus and serum IgE were used as an indicator of immunity^[13].
- **CHIA OIL AS SKIN CURATIVE:** The likely benefits of topical omega-3 fatty acids, topical products containing chia oil formulated. A topical formulation was prepared by the addition of 4 % chia oil and applied for 8 weeks. Application of topical formulation added with chia oil significantly improved the skin hydration, lichen simplex chronicus, and prurigonodularis^[12].

3. USES OF CHIA SEED

- The approval of chia seed as a Novel Food by the European Parliament has led to high degree of usage of chia seed in a wide range of foods. It is already well established that chia does not have anti-allergic, anti-nutritional and toxic effect on human health. Biscuits, pasta, cereal bars, snacks and yoghurt and cake are usually supplemented with chia seed^[11].
- Chia is one of the few medicinal plants that produce essential oil in a great concentration, which is used for the preparation of omega-3 capsules. Nutritional value of butter oil was enhanced by blending with chia oil from 6.5 % to 25 %, concentration of omega-3 fatty acids in chia fortified butter oil ranged from 4.17 % to 16.74 %^[7].
- These results evidenced the successful application of chia oil to butter oil, however, further study should be performed to study the suitability of chia oil in other dairy products. The oil extracted from the leaves of chia is utilized as scent and condiment^[15].
- It is revealed from the studies that chia seed had a higher concentration of phytosterols which have and cancer and cardio-protective effect with antimicrobial activities^[9].
- Recently, it is established that mucilage of chia seed can be utilized as a functional coating with improved functional properties^[10].

4. OBJECTIVES OF STUDY

- To conduct consumer awareness survey on Chia seeds and its products.

- To provide Nutrition education on Nutritional importance and health benefits of Chia Seeds.
- To conduct a market survey for the availability of Chia seeds and its products.
- To formulate Apple Smoothie and Multigrain Biscuits using Chia Seeds.
- To standardize the ingredients and method involved in the development of Apple Smoothie and Multigrain Biscuits.
- To conduct subjective evaluation of Apple Smoothie and Multigrain Biscuits.
- To calculate and analyze Protein and Fibre of Apple Smoothie and Multigrain Biscuits developed using Chia Seeds.
- To calculate the cost of the developed products.

II. EXPERIMENTAL DETAILS

1. CONSUMER AWARENESS SURVEY

a. Sample Size And Selection Of Subjects: The sample size consists of a total of 25 subjects. The sample includes the teaching staff of University College for women, Osmania University belonging to different fields and levels of education.

b. Tools And Techniques: Consumer awareness on Chia seeds was conducted using questionnaire method. Questionnaire was developed in English language.

2. NUTRITION EDUCATION:

In order to educate the consumers Nutrition education materials were distributed which includes Nutritional information, Health benefits of Chia Seeds and different recipes made out of Chia seeds.

3. MARKET SURVEY:

A Market survey was conducted in the city of Hyderabad. Whereas, Super Markets, Food outlets, General stores were visited in different areas of Malakpet, Abids, Kachiguda, Mehdipatnam, Banjara Hills, Tolichowki to know the availability of Chia Seeds and its products.

4. PRODUCT DEVELOPMENT:

Product development in a Nutritional context means the act of developing a basic product in to a new or value added product which is high in terms of Nutrients and other health benefits.

a. Place of Study: The products were developed at the Department of Food And Nutrition, University College for Women, Osmania University, Koti, Hyderabad. Two highly nutritious products were developed using varying amounts of Chia seeds.

b. Procurement of Sample: Ingredients used for preparation of both the recipes were easily available in Super Markets, General stores and at Dawasaz.

5. FORMULATION OF THE PRODUCT

i) CHIA APPLE SMOOTHIE

Method of Preparation:

- Take an apple peel and chop it into small pieces.
- Beat the curd in a bowl.
- Now, add all the ingredients and honey in blender or food processor until smooth and serve in a glass.

Note: In variations, varying amounts of powdered Chia seeds are added

INGREDIENTS	BASIC	V- 1	V- 2	V- 3
Apple (g)	100	100	100	100
Yogurt (g)	100	100	100	100
Almond Powder(g)	5	5	5	5
Honey (g)	10	10	10	10
Chia Seeds (g)	-	5	10	15

ii) MULTIGRAIN CHIA BISCUITS

Method of Preparation:

- Mix all the flours in a bowl and sieve.
- Take another bowl and add sugar, Butter and Vanilla essence and cream it till soft.
- To this creamed mixture add mixture of flours, milk powder, Custard powder, Cardamom powder and baking powder.
- Mix the contents with milk and water to
 - Make the dough of desired consistency.
 - Using a wooden rolling pin the dough was sheeted to a uniform thickness and cut into required shapes.

NOTE: In variations, Add powdered Chia seeds in varying amounts.

INGREDIENTS	BASIC	V- 1	V- 2	V- 3
All Purpose Flour(g)	30	30	30	30
Jowar Flour(g)	10	10	10	10
Bajra Flour (g)	10	10	10	10
Oats Flour (g)	10	10	10	10
Soya Flour (g)	10	10	10	10
Milk Powder(g)	10	10	10	10
Custard Powder (g)	10	10	10	10
Butter (g)	10	10	10	10
Sugar (g)	10	10	10	10
Milk (ml)	15	15	15	15
Almond (g)	5	5	5	5
Cashew (g)	5	5	5	5
Cardamom (g)	1	1	1	1
Chia Seeds Powder (g)	-	5	10	15

6. STANDARDISATION: Standardization is a process where a recipe is tested and found consistently satisfactory in quality and yield.

7. SENSORY EVALUATION: Sensory evaluation is a combination of different senses of perception coming into play in choosing and eating a food. Appearance, flavor and mouth feel decide the acceptance of food.

i. Selection of panelists:

25 Panelists were selected for both the trials of evaluation of sensory attributes of prepared recipes. The panelists included were the students of Department of Food &

Nutrition, University College for Women, Osmania University. The sensory evaluation of both the basic and variations was done using scale hedonic rating scale.

ii. Development of score card:

The developed products were tasted and rated on a scale of 5 based on the following sensory attributes like appearance, taste, color, texture, overall acceptability. Score card consist of the name of the judge, date and time.

8. CALCULATION AND ANALYSIS OF NUTRIENTS:

The Nutritive value was calculated for both the basic and variations (B.S.NarsingaRao et al., 2014)

9. NUTRIENT ANALYSIS: The Nutrients of importance (Protein and Fibre) in the above recipes of basic and the best variation of Chia Apple Smoothie and Multigrain Chia Biscuits was analyzed using the standard methods of AOAC.

10. STATISTICAL ANALYSIS OF DATA: The data collected will be statistically analyzed during “t” test.

$$t = \frac{X_1 - X_2}{\sqrt{\left(\frac{(N_1 - 1)S_1^2 + (N_2 - 1)S_2^2}{N_1 + N_2 - 2} \right) \left(\frac{1}{N_1} + \frac{1}{N_2} \right)}}$$

where x1 and x2 are the means of first and second samples respectively.

III. RESULTS AND DISCUSSION

1. CONSUMER AWARENESS ON CHIA SEEDS: It was done by distributing Questionnaires to the staff of different departments of University College for Women, Osmania University, Koti, Hyderabad.

i) General Information Of Panelists Selected For Consumer Awareness

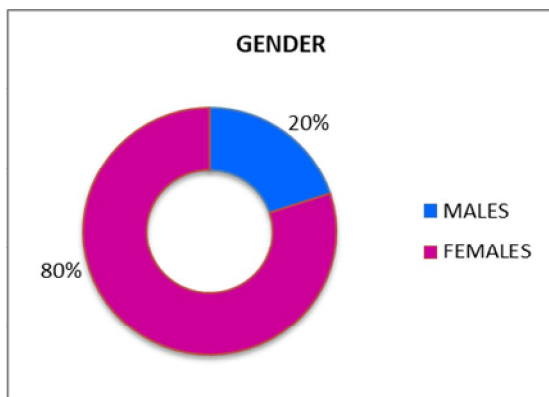


Fig: (i)a

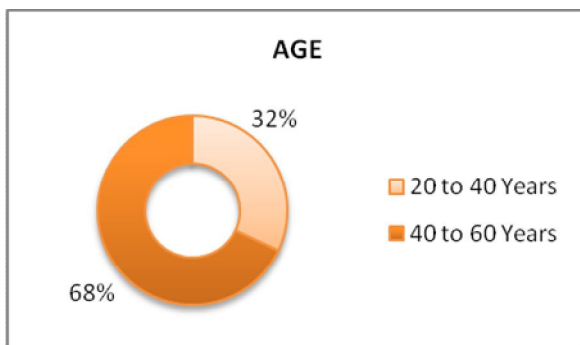


Fig: (i) b

FIGURE (i): General Information of Panelists Selected For Consumer Awareness

ii) Eating Practices of Panelists Selected For Consumer Awareness

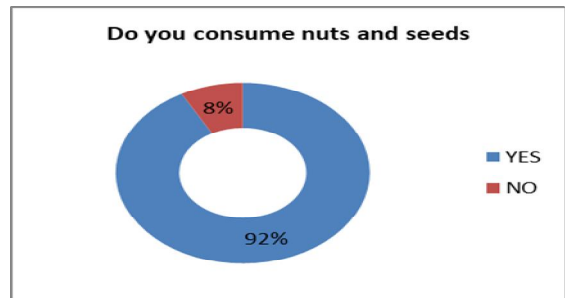


Fig: (ii) a

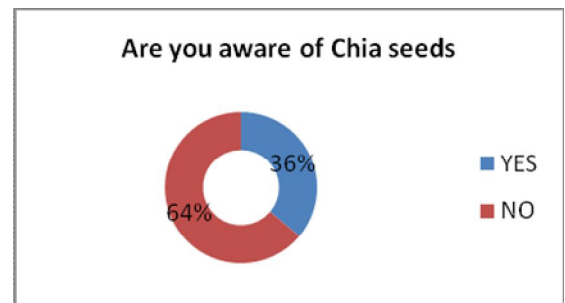


Fig: (ii) b

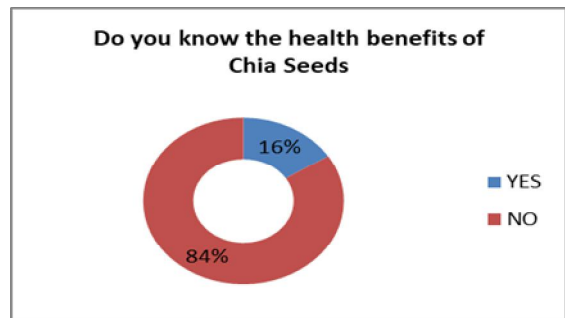


Fig: (ii) c

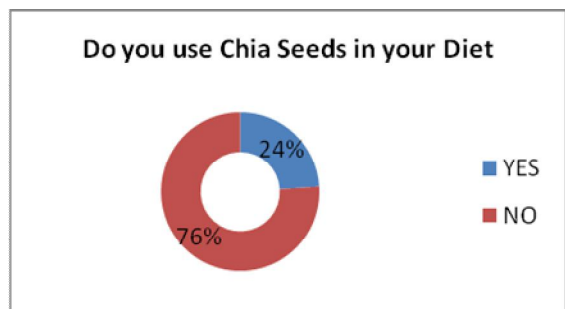


Fig: (ii) d

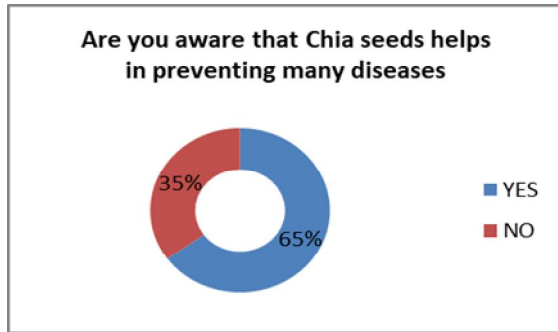


Fig:(ii) e

FIGURE (ii): Eating Practices Of Panelists Selected For Consumer Awareness

The Questionnaire consists of about 17 open and closed ended questions. Panelists were requested to answer all the Questions.

According to the survey it was concluded that about 36% of panelists were known about the chia seeds and 64% were unaware of it among them 16% of were aware of health benefits of chia seeds and 84% were unaware and 24% of panelists use Chia seeds in their diet.

After completion of the survey every panelist was educated about the health benefits, Nutritional importance and Nutritive value of Chia Seeds. They were also explained about the different ways in which Chia seeds can be used in daily diet.

2. MARKET SURVEY

A visit was made to 20 super markets, 15 general stores and 15 Dawasaaz stores inorder to conduct market survey on Chia seeds in different areas of Hyderabad.

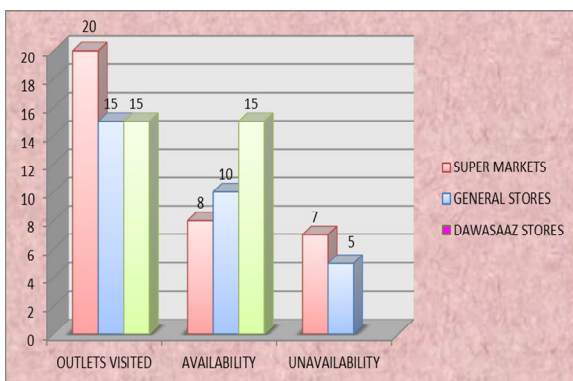


FIGURE: Comparison Of Availability and Unavailability of Chia Seeds in Outlets Visited In Hyderabad.

Different areas Super Markets, Local and Dawasaaz stores of Hyderabad were visited to conduct a market survey on availability of Chia seeds and its products. As per the research it was concluded that the Chia seeds are available in the market under different brands.

These are available under different names such as Sabja Seeds, Basil Seeds or Falooda seeds and in different varieties like White Chia Seeds, Black Chia Seeds, Raw or Roasted Chia Seeds, Organic Chia Seeds. It was an interest to know that Chia seed is used as a variation in jams.

The Labelled information like net weight, cost, shelf life, certification mark, ingredient list and Nutritional information were recorded from the products.

3. PRODUCT DEVELOPMENT

3.1. Result of Sensory Evaluation For Chia Apple Smoothie

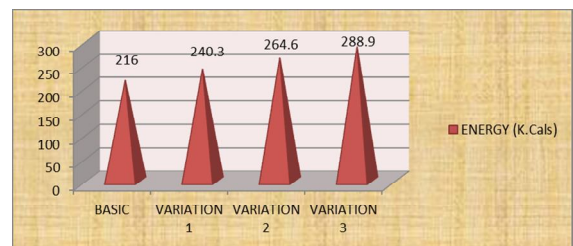


Fig: 3.1(a)

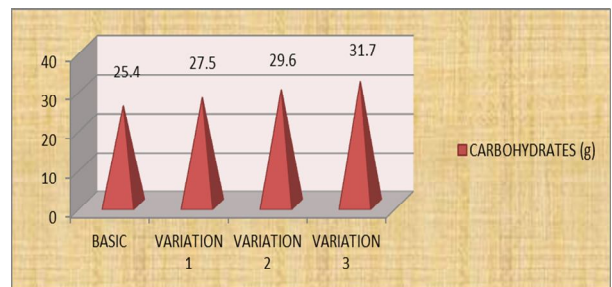


Fig: 3.1(b)

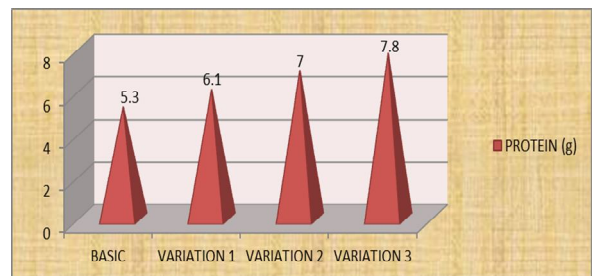


Fig: 3.1(c)

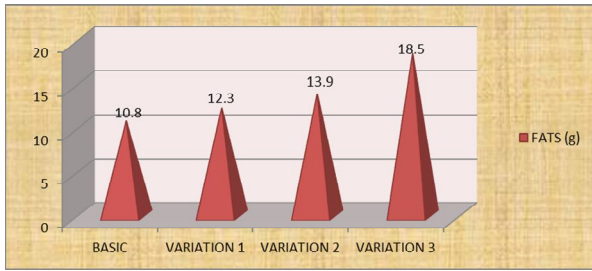


Fig: 3.1(d)

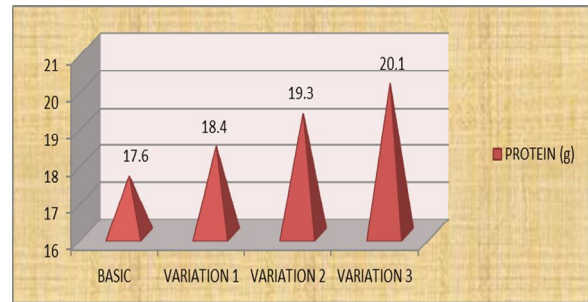


Fig: 3.2(c)

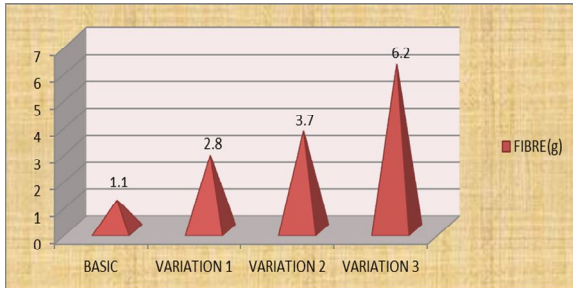


Fig: 3.1(e)

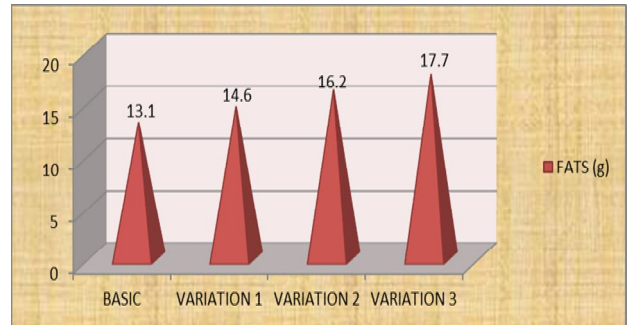


Fig: 3.2(d)

FIGURE 3.1: Comparison of sensory attributes of basic and variations of Multigrain Chia Biscuits. (a) Appearance; (b) Taste; (c) Texture; (d) Flavor; (e) Overall Acceptability .

3.2. Result of Sensory Evaluation For Multigrain Chia Biscuits

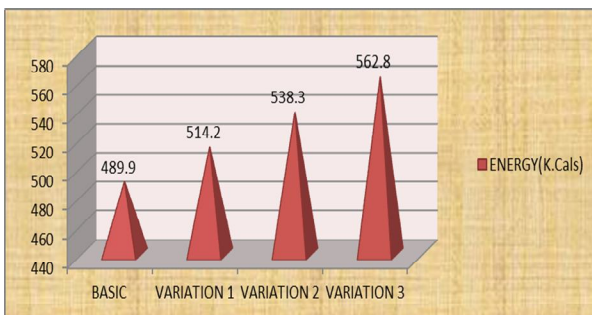


Fig: 3.2(a)

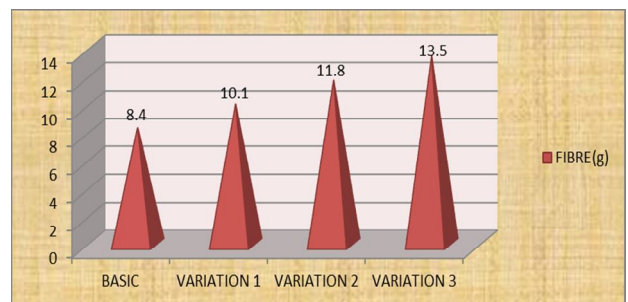


Fig: 3.2(e)

FIGURE 3.2: Comparison of sensory attributes of basic and variations of Multigrain Chia Biscuits. (a) Appearance; (b) Taste; (c) Texture; (d) Flavor; (e) Overall Acceptability .

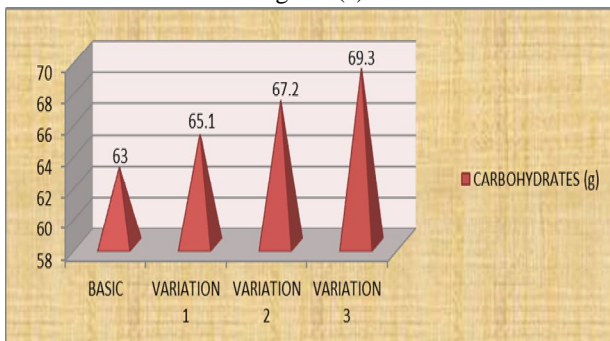


Fig: 3.2(b)

Sensory evaluation was done for both the recipes (Chia Apple Smoothie and Multigrain Chia Biscuits) in two trials. There are 25 panelists for each trial.

From the mean calculated for appearance, taste, texture, flavor and acceptability of basic and the three variations for two products Chia Apple Smoothie and Multigrain Chia Biscuits, the following conclusions can be made. The mean value for Chia Apple Smoothie Basic was 3.9 which was least, highest mean value was for Variation 2 i.e. 4.3 followed by 4.1 for variation 1 and Variation 3. The mean value for Multigrain Chia Biscuit Basic was 4.4 followed by 4.3 for Variation 1, 4.2 for Variation 2 and 4.0 for Variation 3 respectively. Highest Mean score was for Basic followed by Variation 1, 2 and 3.

3.3(a).t-Test For Variations In Comparison With Basic Chia Apple Smoothie

t VALUE		RESULT	
V 1	1.6	Significant	Ho Accepted
V 2	3.4	Not Significant	Ho Rejected
V 3	1.4	Significant	Ho Accepted

3.3(b).t-Test For Variations In Comparison With Basic Multigrain Chia Biscuits

t VALUE		RESULT	
V 1	0.88	Significant	Ho Accepted
V 2	1.96	Not Significant	Ho Accepted
V 3	3.03	Significant	Ho Rejected

3.4. Difference Between The Calculated Nutritive Value Of Basic Chia Apple Smoothie To That Of Variation 1, 2 And 3

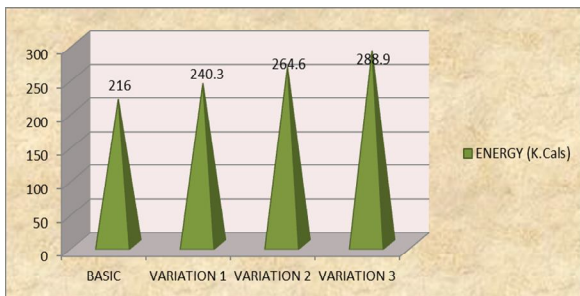


Fig: 3.4 (a)

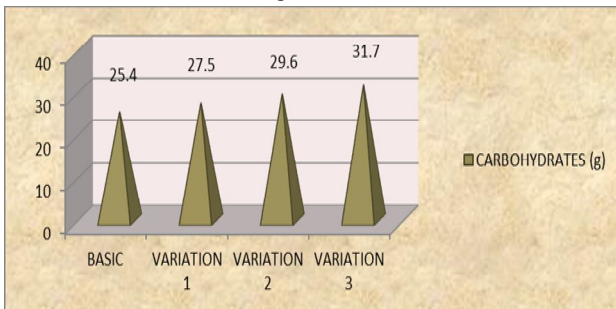


Fig: 3.4 (b)

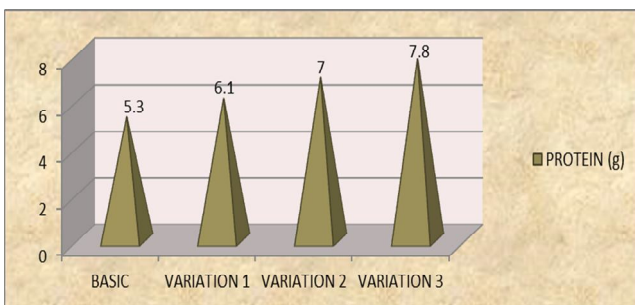


Fig: 3.4 (c)

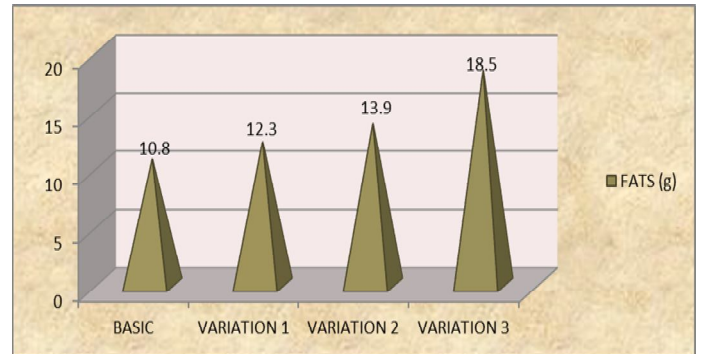


Fig: 3.4 (d)

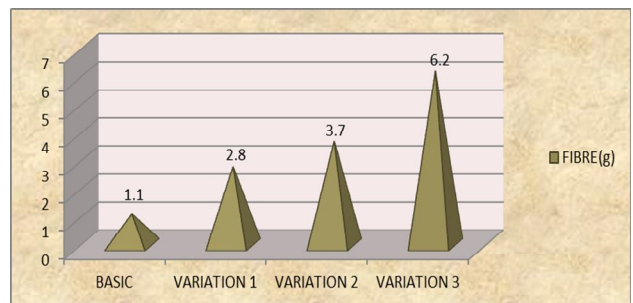


Fig: 3.4 (e)

FIGURE 3.4: Comparison of Nutrients of Chia Apple Smoothie Basic, Variation 1, 2 and 3

3.5. Difference Between The Calculated Nutritive Value Of Basic Multigrain Chia Biscuits To That Of Variation 1, 2 And 3

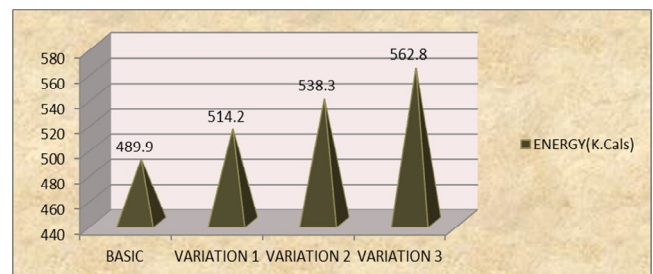


Fig: 3.5 (a)

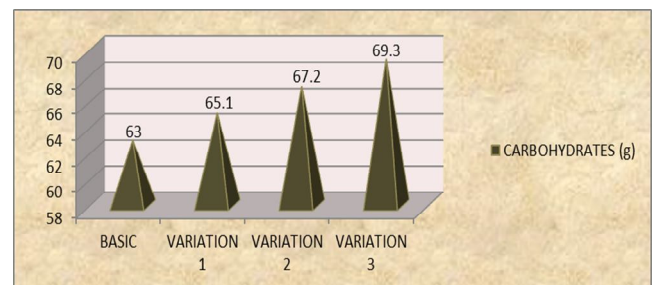


Fig: 3.5 (b)

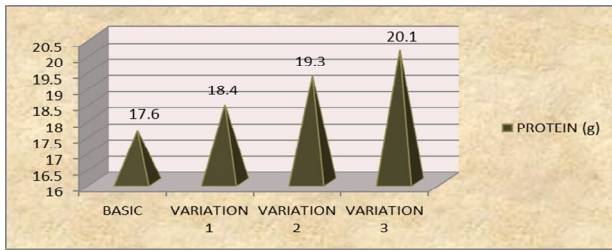


Fig: 3.5 (c)

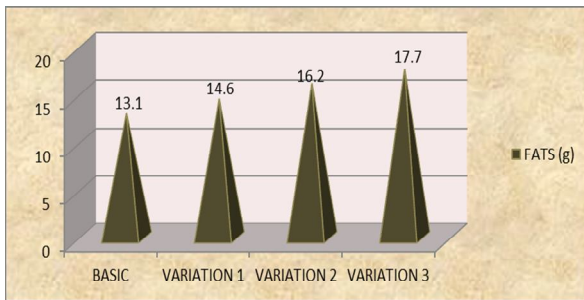


Fig: 3.5 (d)

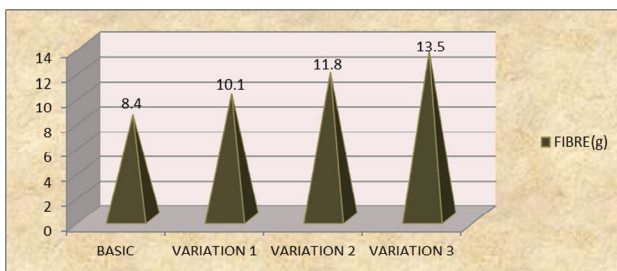


Fig: 3.5 (e)

FIGURE 3.5: Comparison of Nutrients of Multigrain Chia Biscuits Basic, Variation 1, 2 and 3

The Nutritive Value of Chia Apple smoothie and Multigrain Chia Biscuits increased from Basic to Variation-3 due to addition of Chia seeds in varying amounts (i.e.Variation-1 5g; Variation-2 10g; Variation-3 15g).

The important Nutrients in the above recipes are analyzed. Dried samples of the Multigrain Chia Biscuits basic and the best variation (variation-1) and Chia Apple Smoothie basic and best variation (Variation-2) were sent to the laboratory for Nutrient analysis. The result came out are as follows:

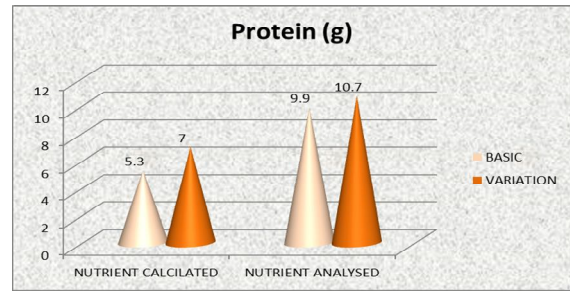
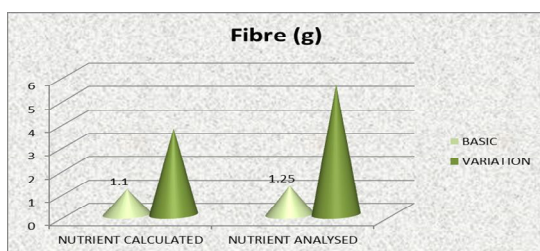


FIGURE: Comparison of Protein and Fibre content of Nutrient analyzed and Nutrient Calculated for Chia Apple Smoothie Basic and Variation 2

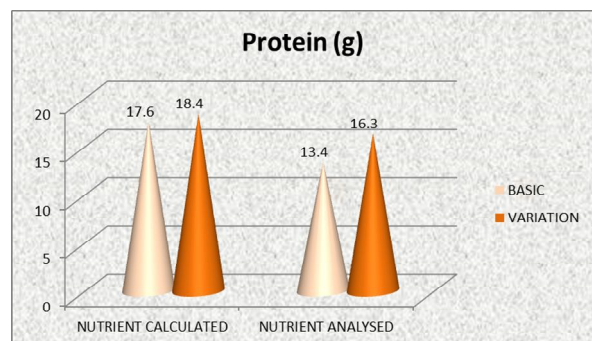
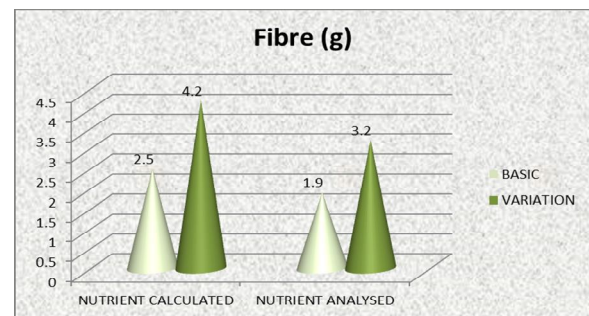


FIGURE: Comparison of Protein and Fibre content of Nutrient analysed and Nutrient Calculated for Basic and Variation-1 of Multigrain Chia Biscuit

The gradual decrease in the values of Nutrient analyzed when compared to the value of Nutrient calculated was may be due to the losses during cooking.

IV. SUMMARY AND CONCLUSION

From the findings it was concluded that many of the consumers were unaware of Chia seeds. As the study was done on a total of 25 subjects of which 80% were female and 20% were male. As per the study majority of people were in the age group of 40-60 years

A questionnaire method was followed to find out the awareness of Chia Seeds. It was observed that 64% of subjects

were unaware and 36% were only aware of Chia Seeds among them only 16% were known about its health benefits.

A market survey was done for the availability of Chia Seeds and its products in different supermarkets, general stores and Dwasaz in different areas of Hyderabad.

Chia Apple Smoothie and Multigrain Chia Biscuits were developed using Chia Seeds. The method of preparation was same for both basic and variations in both the products except for the addition of Chia Seeds in variations.

All the variations were formulated and standardized by conducting repeated trials. In Chia Apple Smoothie variation 2 and Variation 1 in Multigrain Chia Biscuits accepted as the best variation by majority of the panelists.

The Nutritive value calculation was done for both the recipes and Nutrients estimated were fibre and Protein in both the recipes was carried out using standard methods given by Prof. JayashankarTelangana Agricultural University, Quality Control Laboratory. Rajendranagar, Hyderabad.

Statistical analysis was carried out by applying t test and the results found was significant for Variation 1 and 3 insignificant for Variation 2 in Chia Apple Smoothie and significant for Variation 1 and 2 and insignificant for Variation 3 in multigrain Chia biscuits.

REFERENCES

- [1] YiDingHui-WenLin, Yi-LingLin, Deng-JyeYang, Yu-ShanYu, Jr-WeiChen, Sheng YaoWang, Yi-ChenChen, "Nutritional composition in the chia seed and its processing properties on restructured ham-like products" in Journal of Food and Drug Analysis, vol.10, pp. 1-11, 2017.
- [2] Bhavsar g j, Sawate A R, Kshirsagar R B "Effect of Replacement of Refined Wheat Flour with Buckwheat Flour on Quality Characteristics of Cookies" in Indian journal of Nutrition and Dietetics, vol. 52, no.1, pp. 88-96, 2015.
- [3] Balaswamy K, PrabhakaraRao P G, Nagender A, NarsingRao, G, Sathiya Mala K, Jyothirmayi T, Math R G, Satyanarayana "A Development of smoothies from selected fruit pulps or juices" in International Food Research Journal, vol. 20, no. 3, pp. 1181-1185, 2013.
- [4] Josephine Nirmala Many and V. SarasvathiBharathidasan "Short Communication Analysis of Chia Seed" in Research Journal of Recent Sciences, vol. 5, no. 8, pp. 39-41, 2016.
- [5] Aleksandra Sędzikowska, MaciejOseka, Beata Roman, Emilia Jaremko"Impact of Salvia and Peppermint Oil on the In Vitro Survival of Demodex Mite" in Journal of Bacteriology and Parasitology, vol.6, no. 3,pp. 1-3, 2015.
- [6] RahmanUllah, NadeemM, Ahmad S, Azeem MW, Tayyab M "Fractionation of Chia Oil to Enhance Omega 3 & 6 Fatty Acids: Oxidative Stability of Fractions" in Food Sci Biotech, 2015.
- [7] Nadeem M, Ajmal M, Rahman F, Ayaz M "Analytical characterization of butter oil enriched with omega-3 and 6 fatty acids through chia (*Salvia hispanica* L.) seed oil" in Pak J of Anal EnviChem, 2015.
- [8] Alfredo Vazquez Ovando, David BetancurAncona, Luis Chel-Guerrero "Physicochemical and functional properties of a protein-rich fraction produced by dry fractionation of chia seeds (*Salvia hispanica*)" in Journal of Food, vol. 11, no. 2, pp. 75–80, 2013.
- [9] Alonso-Calderon A, Chávez-Bravo E, Rivera A, Montalvo-Paquini C, Arroyo-Tapia L "Characterization of Black Chia Seed (*Salvia hispanica* L) and Oil and Quantification of β -sitosterol" in International Research Journal of Biological Sciences, vol.2, no.1, pp.2278 – 3202, 2013.
- [10] Munoz LA, Aguilera JM, Rodriguez-Turienzo L, Cobos A, Diaz O "Characterization and microstructure of films made from mucilage of *salvia hispanica* and whey protein concentrate" in J Food Eng, vol.111, no. 3, pp. 511–518, 2012
- [11] Borneo R, Aguirre A, León AE. Chia (*Salvia hispanica* L) "gel can be used as egg or oil replacer in cake formulations" in J Am Diet Assoc, vol. 110, no. 6, pp. 946–949, 2010
- [12] Jeong SK, Park HJ, Park BD, Hwan Kim H "Effectiveness of Topical Chia Seed Oil on Pruritus of End-stage Renal Disease (ESRD) Patients and Healthy Volunteers" in Ann Dermatol, vol. 22, no.2, 2010
- [13] Fernandez I, Vidueiros SM, Ayerza R, Coates W, Pallaro A "Impact of chia (*Salvia hispanica*L.) on the immune system: preliminary study Proceedings of the Nutrition Society", in (OCE), vol. 12,2008
- [14] Reyes-Caudillo E, Tecante A, Valdivia-Lopez MA "Dietary fibre content and antioxidant activity of phenolic compounds present in Mexican chia (*Salvia hispanica* L.) seeds" in Food Chem, vol. 107, no. 2, pp. 656–663, 2008
- [15] Ahmed M, Hamed R, Ali M, Hassan A, Babiker E "Proximate composition, antinutritional factors and protein fractions of guar gum seeds as influenced by processing treatments" in Pak J Nutr, vol. 5, no. 5, pp. 340–345, 2006
- [16] NorlailyMohd Ali, SweeKeongYeap, Wan Yong Ho, Boon KeeBeh, Sheau Wei Tan and Soon Guan Tan, Pawlosky R, Hibbeln J, Lin Y, Salem N "The Promising

Future of Chia, *Salvia hispanica* L N-3 fatty acid metabolism in women” in . *Br J Nutr*, vol. 10, pp. 990-993, 2003

- [17] Ayerza R, Coates W “Chia seeds: new source of omega-3 fatty acids, natural antioxidants, and dietetic fiber” in Southwest Center for Natural Products Research & Commercialization. Tucson: Office of Arid Lands Studies, 2001.
- [18] Leaf A, Kang JX “Omega-3 fatty acids and cardiovascular disease, The re - turn of T-3 fatty acids into the food supply” I- Land-based animal food products and their health effects, edited by Simopoulos AP. Basel AG: Karger S, pp. 24–37, 1998.