Chia *(Salvia Hispanica L.)* seeds flour fortified gluten free cookies and its nutritional quality

M. Abdur Rahman[1*], A. K. Singh[2], R. N. Shukla[3] and K. S. Gadhe[4]

Department of Food Process Engineering, VIAET
SHUATS, Prayagrag-211007 (UP) INDIA

1*. Ph.D., Scholar, Department of Processing and Food Engineering VIAET, SHUATS, Prayagrag-211007. (UP) INDIA Mobile No. 9890633102. *Email:rahmanfoodtech@gmail.com.

2. Assistant Professor, Department of Processing and Food Engineering, VIAET, SHUATS, Prayagrag-211007. (UP) INDIA.

3. Assistant Professor, Department of Processing and Food Engineering, VIAET, SHUATS, Prayagrag-211007. (UP) INDIA.

4. Associate Professor, Department of Food Technology, VNMKV, Parbhani- 431 401 (Maharashtra). INDIA.

Development of Gluten free cookies incorporated with chia seed

***Abstract*: The present study was carried out with an aim to development and standardization of gluten free cookies. In this study, the gluten-free cookies were developed from Chia (*Salvia Hispanica* L.) seed flour which is a member of mint family and having health related medicinal properties. It is grown throughout the world including Canada, India, China, United States, Ethiopia and all over Europe. Different levels of chia seed flour were incorporated viz., Control (100 % maida + 0 % whole Chia flour), T_1 (95 % maida + 5 % whole Chia flour), T_2 (90 % maida + 10 % whole Chia flour), T_3 (85 % maida + 15 % whole Chia flour) and T_4 (80 % maida + 20 % whole Chia flour). Significant differences were observed for all the organoleptic parameters except texture and grain of cookies after incorporation of chia seed flour. Further, the significant decreasing in colour and appearance score of cookies was observed after incorporation of chia seeds flour. The moisture, protein, crude fiber and ash content of cookies was significantly increased with increased incorporation of chia seed flour level whereas the carbohydrate content was decreasing. The outcome of this research could be used as valuable information for the development of high fiber low gluten cookies after incorporation of 85 % maida + 15 % whole chia flour.**

***Keywords*: Chia seed, physio-chemical properties, fatty acid, gluten free cookies, nutritional quality**

Introduction

The Chia *(Salvia Hispanica L.)* is a purple and white flowering rabi crop and is a member of mint family, commonly known as "sabza" (Gujrati, Hindi and Punjabi). This plant grows to a height up to 60 cm, with slender and very fibrous stems, lanceolate leaves having three veins, up to 4 cm long and 4 mm wide, and its bright blue flowers are up to 3 cm in diameter. The fruit contains a seed known as chia. Chia seed is composed of protein (15 - 25%), fats (30 - 33%), carbohydrates (26 - 41%), high dietary fiber (18 - 30%), ash (4 - 5%), minerals, vitamins, and dry matter (90 - 93%). It also contains a high amount of antioxidants (Ixtaina *et al.,* 2008) The chia seed grain is oval and flat, slightly larger than a sesame seed possessing about 2.5x5.0x1.5 mm size. The history of chia seed cultivation has been found as early as 3,000 B.C. Chia seeds (Salvia hispanica L.) were used by the Aztec tribes in the early history of Mesoamerica. This grain crop was important not only for food, but also for medicines and paints. Chia oil is a centuries-old ingredient that has been rediscovered for today's cosmetics and nutritional applications (Ayerza, 1995). The plant produces small white and dark seeds. Most of the chia population is commercially grown today contains a low percentage of white seeds. Their shapes are oval and in general, the white seeds are somewhat larger than the black ones (Ixtaina *et al.*, 2008).

Chia obtained from natural source have been extensively used as pharmaceutical ingredients for their binding, thickening stabilizing, humidifying, disintegrating and release controlling properties in medicines besides, the additive effect of α-linolenic acid (ALA) and n-3

long-chain PUFA was observed to exhibit cardio-protective effects in women (Vedtofte *et al.*, 2011). Chia is one of the most efficient omega-3 (n-3) sources for enriching foods (Ayerza *et al.*, 2001). Chia oil is extremely high in polyunsaturated fatty acids, particularly ω-3 linolenic acid. The main components are linoleic (17-26%) and linolenic (50-57%) acids (Ting *et al.*,1990).

Further, the FDA proposed the rule for labelling gluten free products to satisfy the demand for high quality gluten free cookies/breads having similar quality of wheat flour based cookies and breads. As per rule the "Gluten free" is a voluntary term and defined as food containing less than 20 ppm of gluten (Rai *et al.* 2014). Therefore, the study is design to develop gluten free cookies incorporated with chia seeds.

Material and Methods

Collection of seeds

The certified organic Chia (*Salvia hispanica L.*) seeds were purchased from Harmony Lifescience laboratory Delhi, India and the Chia Seed was grinded in flour grinder was passed through 200 mesh sieve to get uniform particle size.

Nutritional composition

Nutrient composition viz., moisture, ash, crude fat, crude fiber and crude protein were determined using Official Methods of Analysis of the Association of Official Analytical Chemists (AOAC, 2010) and carbohydrates were determined by (Southgate *et. al.*, 1976)

Preparation of cookies

The cookies were prepared using following ingredients as per the traditional creaming process outlined.

Table.1: Recipe for making of cookies

Sr. No.	Ingredients	Quantity
1.	Maida	100 gm
2.	Sugar	50 gm
3.	Shortening (Fat)	50 gm
4.	Sodium bicarbonate	1 gm
5.	Ammonium bicarbonate	1 gm
6.	Water	20 ml

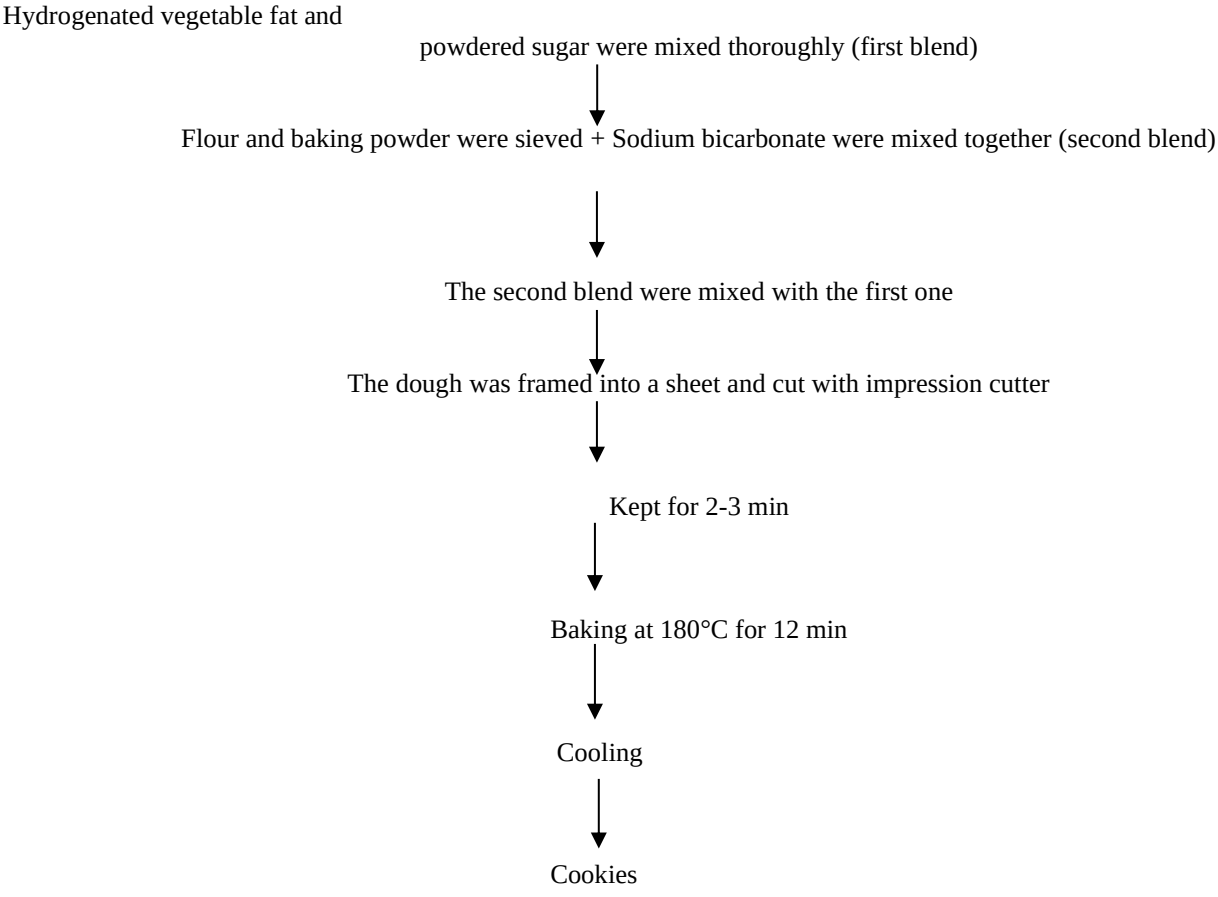

Fig.1. Method for preparation of cookies

Experimental design

Based on review of literature and preliminary trials, the experimental work plan was prepared with details of the treatments as given in Table. 2.

Table.2: Incorporation of whole chia seed in cookies

Sr. No.	Treatments	Whole Chia Seed (%)
1.	Control	100 % maida + 0 % whole Chia flour
2.	T_1	95 % maida + 5 % whole Chia flour
3.	T_2	90 % maida + 10 % whole Chia flour
4.	T_3	85 % maida + 15 % whole Chia flour
5.	T_4	80 % maida + 20 % whole Chia flour

Dependent variables were

1. Proximate composition

Moisture, protein, fat, ash, fiber, carbohydrates and minerals

2. Sensory qualities

Color, appearance, flavor, taste and overall acceptability

Organoleptic evaluation

The prepared products were evaluated organoleptic by the 10 non-trained panelists using a 9-point hedonic scale (Rosa *et al.*, 2005). The index of acceptance (IA per cent) was calculated using the following equation (Schumacher *et al.*, 2010).

IA per cent = M/9 X100

Where M indicates the average of the evaluations carried out by sensory panel.

Results and Discussion

Organoleptic quality

The data for organoleptic evaluation of cookies is present in Table 3. It was clear from the table, cookies prepared from Chia were significant differences for all the organoleptic parameters except texture and grain. The treatment T_3 obtained significantly highest score for texture and grain (8.25), flavor (8.25), crispiness (8.25), taste (8.00) and overall acceptability (8.00) except for color and appearance as compared to other treatments. Colour and appearance score of cookies was significantly decreasing after incorporation of chia seeds but also sensory panelist scored comparable score for treatment T_3 as compared to control. Overall acceptability score of cookies were exhibited highest in treatment T_3 as compared to control and other treatments which were used for further studies.

Table.3: Organoleptic evaluation of gluten free cookies

Treatments	Color & appearance	Texture & grain	Flavor	Crispiness	Taste	Overall acceptability
Control	8.63	7.75	7.75	8.00	7.88	7.88
T_1	8.25	7.50	7.75	7.75	7.75	7.50
T_2	7.75	7.75	8.00	8.00	7.75	7.75
T_3	8.00	8.25	8.25	8.25	8.00	8.00
T_4	7.50	7.25	7.00	7.25	6.75	6.75
Mean	8.03	7.70	7.75	7.85	7.62	7.58
SE ±	0.218	0.316	0.266	0.194	0.239	0.248
CD at 5 %	0.657	NS	0.802	0.584	0.721	0.747

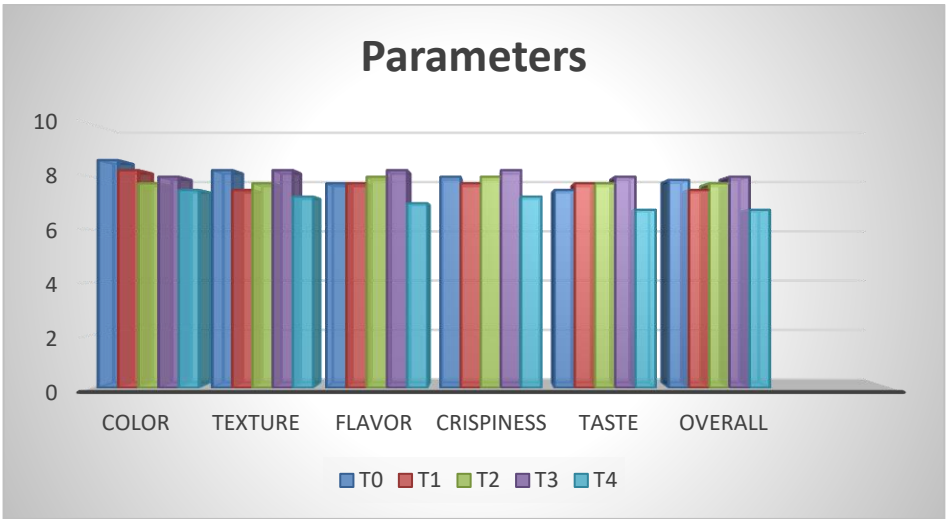

Fig 2: Index of acceptance of gluten free cookies

Nutritional quality

The data for nutritional evaluation of cookies incorporated with chia seed flour is presented in Table 4. The nutritional quality in respect to moisture, protein, crude fiber and ash content of cookies was significantly increased with increasing incorporation of chia seed flour level whereas the carbohydrate content was decreasing. The moisture, protein, crude fiber, ash and carbohydrate content, 4.02, 7.20, 0.53, 1.05 and 62.69 %, respectively for T_3 treatment. The mineral content of cookies prepared with incorporation of chia seed flour was presented in Table 5. The nutritional content in respect to calcium (350 mg/100g), magnesium (685.3 mg/100g), phosphorous (731 mg/100g), iron (9.71 mg/100g) and zinc (7.22 mg/100g) was found in selected cookies T_3 treatment (85 % maida + 15 % whole Chia flour).

Table.4: Nutritional evaluation of gluten free cookies

Treatment	Nutritional quality (%)					
	Crude protein	Crude fibers	Carbohydrates	Moisture	Ash	Crude fat
Control	6.51	0.21	65.43	3.23	0.70	23.71
T_1	6.70	0.34	64.58	3.52	0.81	24.00
T_2	6.91	0.46	63.70	3.76	0.95	24.20
T_3	7.20	0.53	62.69	4.02	1.05	24.52
T_4	7.45	0.62	61.77	4.19	1.26	24.70
Mean	6.95	0.43	63.64	3.74	0.95	24.22
SE±	0.152	0.044	0.290	0.114	0.069	0.124
CD at 5 %	0.459	0.133	0.875	0.343	0.208	0.374

Table.5: Mineral content of gluten free Cookies

Sr. No.	Physical Parameters Per 100gm	Mean Value mg/100g
1	Calcium	350
2	Magnesium	685.3
3	Phosphorous	731
4	Iron	9.71
5	Zinc	7.22

* Each value represents the average of three determinations

Conclusions

It is evident from the experiment that gluten-free cookies could be made by incorporation of 85 % maida + 15 % whole Chia flour (T_3). Further, the nutritional quality in respect to moisture content, ash, crude protein, crude fibers, minerals (P, Zn, Ca, and Fe) of cookies was increased with increase in addition of 15% whole chia seed flour with reduction in carbohydrates and calorific values.

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Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this article.

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