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Effect of fortification of Jamun Seed (*Syzygium cumini*) powder on nutritional and sensory quality of herbal multigrain cookies

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Abstract

The study were designed to replace the refined wheat flour (RWF) with jamun seed powder (JSP) @ 0, 5, 10 and 15% by keeping the proportion of finger millet flour (FMF) constant (15%). The cookies were baked to a temperature of 175°C for 15-20 min for uniform baking. The prepared cookies were subjected to organoleptic and nutritional quality analysis. The sample T₂ was organoleptically accepted over other sample and found to contain moisture (4.87%), fat (13.49%), fiber (1.73%), protein (9.47%), ash (1.11%) and carbohydrate (69.25%). Chemical composition of treatment T₂ (10% JSP) contain high amount of moisture, fat, fiber and ash as compared to treatment T₀ and T₁ and less amount compared to T₃ (15% JSP) but protein and carbohydrate were lower than T₀ and T₁ and higher than T₃. Owing to such attributes, the most important aspect of this study to develop nutritionally enriched herbal multigrain cookies fortified with jamun seed powder. The prepared cookies were feasible to be exploited in market.

Keywords: Refined wheat flour, finger millet flour, Jamun Seed powder, cookies

1. Introduction

Bakery products have become more popular in India since the earlier times. Among the different bakery products, cookies constitute the most popular group. Cookies are widely consumed throughout the world. In fact, they represent the largest category of snack foods in most parts of the world. Herbal medicines are promising choice over modern synthetic drugs. They show minimum or no side effects and are considered to be safe. Generally herbal formulations involve use of fresh or dried plant parts (Modi *et al.*, 2010) [1]. Jamun seed powder has been used for centuries as a natural form for balancing the healthy blood sugar level. It is a very delicious, detoxifying herb which has properties that helps to maintain natural urination and sweating. It also acts as liver stimulant, digestive, coolant and a blood Purifier. Jamun seeds contain a glycoside, named *Jamboline* which helps in the maintenance of glucose levels as in the normal limits (Kalse *et al.*, 2016) [2].

Wheat (*Triticum aestivum*) is staple food crop which occupies important place next to rice in India. Wheat is largely consumed in various forms like breads, biscuits, cookies, cakes, pasta, noodles and is the major source of dietary energy and protein for humans (Hussain *et al.*, 2004) [3]. Whole wheat flour contained moisture content; 12.0, protein; 10.0, fat; 1.6, carbohydrate; 72.6, fibers; 1.3 and ash; 1.49 g/100g respectively. Whole wheat flour contained 43 mg ca, 284 mg p and 45mg iron. Wheat is the major source contributor of protein content of daily diet (Anjum 1976) [4]. Finger millet is well comparable and even superior to many cereals in terms of mineral and micronutrient contents. Finger millet is rich in protein, iron, calcium, phosphorous, fiber and vitamin content. Nutritionally; it has high content of calcium (344 mg/100g), dietary fiber (15% to 20%) and phenolic compounds (0.3% to 3%). This minor millet contains important amino acids viz isoleucine, leucine, methionine and phenyl alanine which are deficient in other starchy meals. It is also known for several health benefits such as antidiabetic, anti-tumorigenic, atherosclerogenic effects, antioxidant, which are mainly attributed due to its polyphenol and dietary fibre contents (Amir *et al.*, 2014) [5].

Ayurvedic text suggests that 1-3 g of jamun seed powder per day is an average dose for the treatment of diabetes (Shorti *et al.*, 1962) [6]. The direct consumption of jamun seed powder is uneasy. Therefore, this work has been undertaken to develop the cookies so that diabetic people will consume it easily and get recommended dose of Jamun seed powder.

Materials and Methods

The jamun fruits (*Syzygium cumini*) were collected from the Department of Botany, College of Agriculture, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani. The proposed research was carried out in Department of food engineering, College of Food Technology, VNMKV, Parbhani.

Preparation of jamun seed powder

Evenly matured disease free and sound jamun fruits have to select. The pulp and seed of jamun fruit was separated by pulper. Then the seed washed in water and dried in tray dryer at 60°C for 48 hours still complete drying and ground the seed in pulveriser to fine powder of average particle size 0.58 mm.

Standardization of recipe for herbal multigrain cookies

A herbal multigrain cookies was prepared by replace the refined wheat flour with jamun seed powder by keeping the proportion of finger millet flour constant.

Table 1: Standardization of recipe for herbal multigrain cookies

Ingredients (g)	T ₀	T ₁	T ₂	T ₃
Refined wheat flour (RWF)	100	80	75	70
Jamun seed powder (JSP)	00	05	10	15
Finger millet flour (FMF)	00	15	15	15
Sugar	60	60	60	60
Fat	45	45	45	45
Baking powder	1.5	1.5	1.5	1.5
Ammonium bicarbonate	1.5	1.5	1.5	1.5
Sodium bicarbonate	1.5	1.5	1.5	1.5
Water (ml)	As per requirement			

Process for preparation of cookies

Firstly, oven was preheated at 170°C. The butter was beaten in a food mixer and sugar was added. Then, sifted flour sample was added in the mixture. The mixture was then mixed and kneaded until it became dough. The dough was moulded into balls, placed on the greased tray and finally, baked in the oven for 15 minutes until a golden brown colour was obtained. They were allowed to cool before being packed in polyethylene bag and stored in cold and dry place until further analysis being done (Norhidayah *et al.*, 2014)^[7].

Table 2: Chemical composition of major ingredients

Ingredients	Moisture (%)	Crude fat (%)	Crude protein (%)	Crude fiber (%)	Ash (%)	Carbohydrate (%)
RWF	12.03	1.06	10.71	1.07	0.91	75.67
FMF	11.26	1.29	7.61	3.41	1.02	73.31
JSP	14.31	1.02	3.01	4.21	2.87	73.21

Ash content JSP was observed highest (2.87%) compared to FMF (1.02%) and RWF (0.91%). Carbohydrate content of RWF (75.67%) was highest than FMF (73.31%) and JSP (73.21%). These results were in accordance with earlier findings reported by Prasad *et al.*, (2010)^[12], who depicted that JSP consisted of 9.34±1.99% moisture, 2.42±0.44% crude protein, 0.92±0.52% crude fat, 6.08±1.11% crude fiber and 2.93±0.82% ash. Similar results with respect to proximate composition of RWF and FMF were recorded by Desai *et al.*, (2010)^[11].

Minerals composition of major ingredients

The data in the table 3 revealed estimated mineral composition of RWF, FMF and JSP. RWF found to content of calcium (41 mg/100g), magnesium (137 mg/100g), iron (3.2 mg/100g) and potassium (261 mg/100g). Whole wheat flour

Physical properties

The weight (g), diameter (mm), thickness (mm) and spread ratio of cookies were calculated as per AACC (2006)^[8] methods. Spread ratio was estimated as ratio of diameter to thickness of cookies.

Chemical composition

The proximate composition like protein, carbohydrate, fat, crude fibre and ash were measured as per standard method given in AOAC, 1990^[9].

Minerals composition

The first step for mineral content determination was digestion of the sample (0.5g) in concentrated HNO₃ (AOAC 2000)^[10]. Then 50 ml volumetric flask was used for further analysis and digested sample was mixed with water and volume make up was done. Microwave Plasma-Atomic Emission Spectrometer (Agilent 4100 MP-AES system, USA) was used for mineral analysis against respective aqueous standards and was expressed as mg/100g.

Sensory Evaluation

The prepared cookies samples were organoleptically evaluated on the basis of 9-point Hedonic scale.

Result and Discussion

Chemical composition of major ingredients

The proximate composition of RWF, FMF and JSP were assessed and findings are presented in Table 2. According to the results obtained. The moisture content of RWF (12.03%) was slightly higher than FMF (11.26%) and slightly lower than JSP (14.31%). FMF contains slightly higher percentage of crude fat (1.29%) as compared to RWF (1.06%) and JSP (1.02%). Protein content of flours varied with large extent the highest protein content was recorded in RWF (10.71%) followed by FMF (7.61%) and lowest protein content was observed in JSP (3.01%). The crude fiber was found highest in JSP (4.21%) followed by FMF (3.41%) and lowest fiber was observed in RWF (1.07%).

contained 43mg ca, 284mg p and 45mg iron (Thorat and Khemnar 2015)^[13].

Table 3: Minerals composition of major ingredients

Ingredients	Minerals composition (mg/100g)			
	Calcium	Magnesium	Iron	Potassium
RWF	41	137.9	3.2	261.54
FMF	325	141	4.81	287
JSP	141.71	117.5	4.6	619.41

FMF found to content calcium (325 mg/100g), magnesium (141 mg/100g), iron (4.8 mg/100g) and potassium (287 mg/100g). Vadivoo *et al.*, (1998)^[14] reported the calcium content of 36 genotype of finger millet ranged from 162-487 mg/100g with mean value of 320.8 mg/100g. However slight variations in mineral composition observed were may be due to location of crop, season of year, plant population, selection

of variety and fertilizer application (Singh and Raghuvanshi, 2012) [15]. Mineral elements of JSP like calcium, magnesium, iron and potassium were assessed. JPS found to content calcium (141.71 mg/100g), magnesium (117.5 mg/100g), iron (4.6 mg/100g) and potassium (619.41 mg/100g). These results were in accordance with earlier findings reported by Ghosh *et al.*, (2017) [16].

Table 4: Sensory evaluation of herbal multigrain cookies

Treatment (Sample)	Sensory Attributes				
	Color and Appearance	Flavour	Taste	Texture	Overall Acceptability
T ₀	6.7	7.1	7.3	6.5	7.0
T ₁	6.5	7.5	7.2	7.0	7.1
T ₂	6.5	7.5	7.5	7.5	7.3
T ₃	6.2	7.0	7.0	7.1	6.8

T₀- 100% (RWF)

T₁- 80% (RWF) + 5% (JSP) + 15% (FMF)

T₂- 75% (RWF) + 10% (JSP) + 15% (FMF)

T₃- 70% (RWF) + 15% (JSP) + 15% (FMF)

It was evident from table that the acceptability of the cookies of refined wheat flour, finger millet flour and jamun seed powder based cookies assessed by incorporating (5 %) to (15%) jamun seed powder and (15%) finger millet flour in refined wheat flour and standardized for the sensory evaluation during initial trials it was found that jamun seed powder if used at more than (15%) concentration then it was unacceptable in the given recipes. these was because incorporating jamun seed powder at these level affected the taste (bitter) and colour (darker). The incorporation of jamun seed powder at 10% and finger millet flour 15% in the refined wheat flour (T₂ - 75% RWF + 10% JSP + 15% FMF) produced good result. The current results are in accordance with the findings of Thorat and Khemnar (2015) [12].

Physical properties of herbal multigrain cookies:

The data regarding weight, diameter, thickness and spread ratio as presented in following Table 5. It was evident from table 5 that weight of cookies reduced from 11.80g to 11.76g with the increased level of finger millet flour and jamun seed powder in cookies. In the control cookies weight was highest 11.80g whereas cookies with 70 % refined wheat flour, 15% finger millet flour and 15% jamun seed powder was lowest in weight 11.76g. Similar results given by Akapapunam and Darbe, (1994) [17] in the study of groundnut maize flour.

Table 5: Physical properties of herbal multigrain cookies

Treatments	Weight (g)	Diameter (mm)	Thickness (mm)	Spread ratio
T ₀	11.80	41.7	7.00	6.00
T ₁	11.80	41.9	6.81	6.10
T ₂	11.79	41.11	6.70	6.13
T ₃	11.76	41.12	6.65	6.18

Table 6: Chemical composition of herbal multigrain cookies

Sample	Moisture (%)	Fat (%)	Fiber (%)	Protein (%)	Ash (%)	Carbohydrate (%)
T ₀	4.15	13.21	1.02	10.61	0.97	70.01
T ₁	4.82	13.47	1.57	9.85	1.01	69.28
T ₂	4.87	13.49	1.73	9.47	1.11	69.25
T ₃	4.89	13.51	1.88	9.08	1.21	69.12

Increase in fiber might be due to high fiber content in jamun seed powder (4.21%) and finger millet flour (3.41%) as compare to refined wheat flour (1.07%). Treatments T₁, T₂

Sensory evaluation of herbal multigrain cookies

Cookies were evaluated with respect to different sensory parameters namely color and appearance, flavour, taste, texture and overall acceptability by the panels judges. Sensory score of cookies with different jamun seed powder replacement in wheat flour and finger millet flour is presented in Table 4.

Diameter of cookies increased progressively from 41.7mm (T₀) to 41.12 mm (T₃). This increase in diameter of cookies may be due to increased concentration of multigrain flour in cookies. Thickness of cookies varied from 6.65 mm (T₃) to 7.00 mm (T₀). Highest score for thickness was observed in cookies with 100% refined wheat flour whereas lowest score for thickness was observed in cookies with 70 % refined wheat flour, 15% finger millet flour and 15% jamun seed powder. Spread ratio of cookies is related with diameter and thickness of cookies. Highest score for spread ratio was observed in T₃ (6.18) cookies. Spread ratio of cookies increased with the addition of finger millet flour and jamun seed powder in refined wheat flour from 6.10 to 6.18. The increased spread ratio observed in multigrain cookies samples was due to the difference in the particle sizes and characteristics of flour. Similar trend of results was given by Agu *et al.*, (2007) [18] in wheat and African breadfruit composite cookies.

Chemical composition of herbal multigrain cookies

Chemical composition of cookies with different level of jamun seed powder and finger millet flour is presented in Table 6. Moisture content is of great significance in bakery products for acceptability and storage stability. Generally low moisture content is desired in cookies for increasing their shelf life. The moisture content of cookies increased linearly from 4.15% to 4.89% with increased level of jamun seed powder and finger millet flour in cookies. Cookies with 100% refined wheat flour (T₀) showed lowest moisture content (4.15%) whereas highest moisture content (4.89%) was recorded in cookies with 15% jamun seed powder and 15% finger millet flour (T₃). Fat content of cookies increased from 13.21 (T₀) to 13.51 (T₃). Highest fat was observed in T₃ (13.51) whereas lowest fat was observed in T₀ (13.21). This increase in fat may be due to fortification of finger millet flour and jamun seed powder in refined wheat flour. Progressive increase in fiber content of cookies was observed from T₀ (1.02%) to T₃ (1.88%).

and T₃ contained more fiber as compare to T₀. It might be due to addition of jamun seed powder and finger millet flour in all three treatments. Similar results about increase in fiber

content of cookies were reported by Sharif *et al.*, (2009) ^[19] due to supplementation of defatted rice bran in cookies. Protein content of cookies decreased linearly with decreasing level of refined wheat flour. The highest protein content 10.61 was observed in cookies with 100% refined wheat flour (T₀) whereas lowest protein content 9.08 was observed in control cookies (T₃). The decrease in protein content may be due addition of jamun seed powder and finger millet flour less percentage of protein as compare to refined wheat flour.

Ash content in food substances indicate inorganic remains when the organic matter has been burnt away. Ash content varied significantly from T₀ (0.97%) to T₃ (1.21%). High ash content (1.21 %) was observed in T₃ sample of cookies followed by T₂ (1.11%), T₁ (1.01%). Increase in ash content may be due to addition of jamun seed powder and finger millet flour. The increase in level of millets in blend increased ash content has been also reported by Kamaraddi and Shantakumar, (2003) ^[20]. Carbohydrate content of cookies reduced from T₀ (70.01%) to T₃ (69.12%). The reduction in carbohydrate content may be due to replacement as jamun seed powder and finger millet flour in cookies. Singh *et al.*, (2005) ^[21] reported that addition of milled millet flour to wheat flour increased the concentration of protein, fat and ash but decreased carbohydrates.

Minerals composition of herbal multigrain cookies:

The mineral (calcium, magnesium, iron and potassium) composition of the cookies fortified with jamun seed powder and finger millet flour sample were shown in Table 7.

Table 7: Minerals composition of herbal multigrain cookies

Sample	Minerals composition (mg/100g)			
	Calcium	Magnesium	Iron	Potassium
T ₀	50.37	137.80	3.40	271.47
T ₁	88.63	137.34	3.51	283.23
T ₂	93.60	135.65	3.58	301.11
T ₃	98.70	135.30	3.65	319.03

It could be observed from table 6 that calcium, iron and potassium of cookies increased by replacement of jamun seed powder and finger millet flour in cookies. Calcium content was increased from 50.37mg/100g to 98.70mg/100g. The increase in calcium content is almost 2 times than control (T₀) sample. Iron content of cookies was increased from 3.40mg/100g to 3.65mg/100g and potassium content from 271.47 to 319.03mg/100g and magnesium content were decreased 137.80mg/100g to 135.30mg/100g. This may be due incorporation of mineral rich jamun seed powder and finger millet flour in composite cookies. The results of present investigation are in close agreement with the findings of Desai *et al.*, (2010) ^[11] in preparation of malted finger millet cake where mineral content was found to be increase with the addition of finger millet in cake.

Conclusion

A good quality of herbal multigrain cookies having nutraceutical value can be prepared from different combinations of refined wheat flour (RWF), finger millet flour (FMF) and jamun seed powder (JSP). The addition of 75% (RWF), 10% (JSP) and 15% (FMF) in the recipe improved the organoleptic, nutritional and textural quality of prepared cookies.

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