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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(10): 2432-2435

www.thepharmajournal.com
Received: 08-07-2021
Accepted: 21-09-2021

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Proximates and Sensoric attributes of sprouted Ragi flour (SRF) supplemented cookies

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Abstract
Cookies are widely consumed baked products which can be served as breakfast to bedtime snack. Different prescribed methods were used to evaluate the treatments. Cookies were prepared by substituting maida (RWF) with sprouted ragi millet flour (SRMF) at 0, 05, 10, 15, 20 and 25% levels and evaluated for nutritional and sensorial quality parameters. There was decrease in carbohydrates, proteins, fat and energy values and increase in moisture, ash, amylose and crude fibre. The minerals calcium, phosphorus and iron, was increased on substitution of maida with SRMF in different proportionate. Supplementation of SRMF increased the overall acceptability with the highest score 7.61 in T5 which shows clear indication to fortification. Hence good quality cookies can be prepared by substituting maida with SRMF upto 25%.

Keywords: Cookies, SRMF, bakery, finger millet and sensory

Introduction
The bakery products are occupying an important place in food industry due to its consistent quality and therefore, has potential to serve as a vehicle for nutrition improvement of population at low cost and without much convincing.
Cookies are ready to eat, convenient, inexpensive and one of the most popular and widely consumed processed food products in India. The per capita consumption of cookies in India is reported to be 8 kg per annum as against 15 kg per annum in developed countries (Shukla and Shipla, 2000) [21].
The annual growth of bakery industry is about 10% and the demand of bakery products are increasing among all sections of people. Cookies are having wider consumption base, relatively long shelf-life, more convenience and good palatability which make it attractive for protein fortification and other nutritional improvements. Cookies are predominantly based on refined wheat flour (RWF) and the blending of RWF with oilseeds and pulses such as soybean, moth bean and chickpea can upgrade the nutritional quality.
Composite flour technology for wheat supplementation with protein rich materials like oilseeds and pulses can become an approach to overcome the malnutrition.
The Indian bakery industry has important place in the industrial map of the country. Bakery products are an item of mass consumption in view of its low price and high nutritive value. Consumers demand healthier bakery products and some of the popular trends in the market are the introduction of low/light, functional, natural and organic products (Jamuna and Suresha, 2012) [13]. In addition to healthier products, consumers are also purchasing products that satisfy their taste buds.
Wheat (*Triticum spp*.) is the important and staple crop of the people in India and around the globe because of fundamental source of calories and nutrients mainly used for milling and baking. It contains moisture 12.8%, protien 11.8%, fat 1.5%, minerals 1.5%, crude fibre 1.2%, carbohydrates 71.2%, Energy value 346 Kcal, Calcium 41mg/100g, Phosphorus 306 mg/100g and Iron 5.3 mg/100g respectively Gopalan *et al*. (2000) [10] and Rana (2020) [19].
Finger millet (*Eleusine coracana*) is small-seeded with different varieties, (Bouis 2000) [6] and (Kaur *et al*.2012) [14].
Its grain has a carbohydrate content of 81.5%, protein 9.8%, crude fibre 4.3%, and mineral 2.7%, crude fibre and mineral content is remarkably higher than those of wheat (1.2% fibre, 1.5% minerals) and rice (0.2% fibre, 0.6% minerals); its protein profile is relatively well balanced Gopalan *et al*. (2000) [10] and Rana (2020) [19].

Materials and Methods

The present research was undertaken on "Preparation and Evaluation of Cookies Supplemented with Ragi Flour" in the Mahatma Gandhi Chitrakoot Gramoday Vishwavidyalaya Chitrakoot, Satna (M.P.).

Experimental Materials: The wheat, and ragi, was procured from the local market and all other ingredients (sugar, vegetable oil, glucose, ammonium bicarbonate, common salt sodium bicarbonate, vanilla and baking powder) were purchased from the retail market and department. The materials were transported to department.

Preparation cookies through selected wheat and ragi sprouted grains

Processing of selected grains: The grains (wheat and ragi) were cleaned to remove the dirt, dust and foreign matter by winnowing.

Sprouting process: Grains were sprouted as described by (Murugkar, 2014) [16].

Development and standardization of baked products (Cookies): Preliminary studies were conducted to standardize the formulation for the development of the different cereal-pulses based baked products (Cookies). Cookies were prepared using the traditional creamery method described by Whitley (1970) [25].

Physical and functional properties: *Bulk Density***:** As per Wang and Kinsella (1976) [24] the bulk densities of cookies were determined. *Water absorption capacity (WAC)***:** Water absorption capacity (WAC) was determined by the method given by Sosulski *et al*. (1976) [22]. *Spread ratio***:** The physical characteristics of cookies and cookies such as diameter, thickness and spread ratio were measured as described in the A.A.C.C. (2000) [1] methods.

Chemical composition: *Moisture***:** Moisture was analyzed using the MBS4 moisture analyzer at 100 °C for 10 minutes. *Protein, Fat, Carbohydrates and Ash* content in the sample was estimated by the procedure indicated in the AOAC (1984) [5]. *Estimation of Minerals*: Minerals content of cookies were estimated through the Gopalan table values (Gopalan *et al*. 2000) [10]. *Energy Value*: The total energy values were estimated with using the values of 4, 4, and 9 for protein, carbohydrate and fat respectively as follows: Total energy (kcal/100g) = [(% available carbohydrates X4) + (% protein X4) + (% fat X9)].

Sensory evaluation: The organoleptic properties of nutritious cookies were evaluated by a nine point hedonic scale as indicated by the Amerine *et al*. (1965) [3].

Statistical analysis: The data were subject to analysis of variance (ANOVA) and the least significance difference to estimate the difference between means through STATA 14.0 software. The Completely Randomized Design (CRD) at 5% level of significant.

Results and Discussion

Proximate composition of wheat and ragi cookies: Moisture: Moisture content is of great significance in bakery products for acceptability and storage stability. The moisture content ranged from 2.90 to 3.80 per cent with increased level of ragi flour. Moisture content was highest in treatment T6 (3.80%) whereas lowest moisture content was found in treatment T3 (2.90%). As per table 2 and findings have agreement with Amir *et al*., (2015) [4].

Carbohydrate: The data showed in table 2 that carbohydrate content was decreased with incorporation of sprouted ragi flour, maximum carbohydrates content in cookies was in T1 (65.94%) whereas minimum was found in T6 (65.43%) though the differences were significant. Similar findings have been supported by Mahgoub (1999) [15] in weaning food formulation.

Crude protein: Protein percentage decreased with incorporation of sprouted ragi flour with the good bioavailability due to sprouting. Results showed that maximum protein content was found in T1 (11.96%), whereas minimum was found in T6 (10.95%) in cookies. The increase in the level of ragi flour in the cookies significantly decreases the protein content of the cookies. Similar results were Similar findings have been observed by Vardis and Trichopoulou *et al*. (2009) [23].

Table 1: Preparation and quality evaluation of developed products with Wheat and ragi sprouts".

S.N.	Wheat	Ragi
1.	100	-
2.	95	5
3.	90	10
4.	85	15
5.	80	20
6.	75	25

Fat: The fat content of wheat and ragi supplemented cookies was ranged from 17.95% to 19.65%. The maximum fat content was found in treatment T1 (19.65%) whereas minimum fat content was found in treatment T6 (17.95%) which was higher than the control wheat cookies are presented in Table 2. These results are close agreement with Curley (2008) [8].

Table 2: Proximate composition of wheat and ragi blended cookies

Treatment	Carbohydrates	Protien	Fat	Fibre	EV	Ash	Ca	P	Fe	Moisture	Amylose
T1	65.94	11.96	19.65	3.17	488.53	1.88	21.37	113.36	2.46	3.35	15.03
T2	65.81	11.71	19.31	3.25	485.22	1.93	30.55	121.18	2.62	3.20	14.74
T3	65.77	11.63	19.04	3.32	483.51	1.99	39.20	129.74	2.80	2.90	14.50
T4	65.71	11.38	18.84	3.39	481.92	2.11	47.81	137.89	2.96	3.70	14.25
T5	65.45	11.21	18.55	3.52	478.61	2.15	56.56	145.69	3.07	3.65	13.73
T6	65.43	10.95	17.95	3.66	473.67	2.32	65.29	154.33	3.20	3.80	13.82
Sem	0.0295	0.0282	0.0334	0.0378	0.0393	0.0340	0.0350	0.0317	0.0395	0.042	0.18
CD	0.0910	0.0869	0.1030	0.1165	0.1211	0.1049	0.1078	0.0978	0.1216	0.129	0.52
CV	0.0779	0.4260	0.3067	1.9355	0.0141	2.8637	0.1565	0.0412	2.4203	2.11	
SIG	S	S	S	S	S	S	S	S	S	S	S

Ash: The maximum ash content was found in treatment T6 (2.32%) whereas minimum ash content was found in treatment T1 (1.88%) which was higher than the control cookies are presented in Table 2. An increase in the ragi flour in cookies increased the ash content of the cookies. Similar finding has been supported by Sharma and Chawala (2011) [20].

Fibre content: The increases in the level of ragi flour in the cookies increased fibre content significantly in the cookies are presented in Table 2. Crude fibre content in sprouted ragi flour blended cookies ranged from 3.17% (T1) to 3.66% (T6). Similar findings have been supported Edema *et al*., (2005) [9].

Energy Value: The energy value of wheat and sprouted ragi flour supplemented cookies was ranged from 473.67 (T6) to 488.53 (T1) Kcal. presented in Table 2. Similar findings have been supported by Mahgoub (1999) [15].

Amylose: The Amylose content of sprouted ragi flour supplemented cookies was ranged from 13.82 (T6) to 15.03 (T1). The supplementation of ragi flour decreased the amylose content. Similar findings have been obtained by Zeng L and Chen C (2018) [26].

Minerals Content of sprouted ragi flour blended cookies

Calcium (Ca): The maximum calcium content was found in treatment T6 (65.29 mg/100g) whereas minimum calcium content was found in treatment T1 (21.37 mg/100g) which was higher than the control wheat cookies. An increase in the ragi flour in cookies increases significantly the calcium content of the cookies are presented in Table 2. The above results were well supported by many workers Agu *et al*., (2007) [2].

Phosphorus (P): The maximum phosphorous content was found in treatment T6 (154.33 mg/100g) whereas minimum phosphorous content was found in treatment T1 (113.36 mg/100g) which was higher than the control wheat cookies. The increase in the level of ragi flour in the cookies significantly increases the phosphorous content of the cookies. Findings are supported by Nicole *et al*., (2010) [17].

Iron (Fe): The iron content of wheat and sprouted ragi flour supplemented cookies was ranged from 2.46 (T1) to 3.07 (T5) mg/100g. This might be due to the incorporation of rich source of iron content ragi. Similar findings have been obtained by Camire (2002) [7] in blended weaning foods.

Effect of supplementation of sprouted ragi flour on sensorial profile

Appearance: Sensory scores of wheat and ragi based cookies ranged from 7.00 to 7.75 in appearance. The maximum appearance was found to be in treatment T3 (7.75) whereas minimum appearance was found to be in treatment T1 (7.00). Appearance was found to be significantly lower in wheat based cookies. More darkness in the appearance of cookies was observed due to Maillard reaction between sugar and proteins,

Colour: Colour is very important parameter in judging the properly baked cookies. The maximum score for colour was found to be in treatment T5 (7.85) whereas minimum was found to be in treatment T1 (7.00). Colour was found to be significantly lower in wheat based cookies as per Hussain *et al*., (2006) [12].

Crispiness: The maximum crispiness was found to be in treatment T5 (7.65) whereas minimum crispiness was found to be in treatment T4 (6.70).Crispiness was found to be significantly equal in wheat based cookies.

Taste: Sensory scores for taste of wheat and ragi based cookies ranged from 6.85 to 7.35 in. The maximum taste was found to be in treatment T5 (7.35) whereas minimum taste was found to be in treatment T6 (6.85) as shown in table 3. Our results support the findings of other works Hooda and Jood, (2005)[11].

Table 3: Sensory score combination of the wheat and ragi cookies

Treatment Mean	Appearance	Colour	Crispiness	Taste	Texture	Overall acceptability
T1	7.00	7.00	7.50	7.20	6.85	7.11
T2	7.60	7.25	6.95	7.05	6.85	7.14
T3	7.75	7.30	7.40	7.70	7.75	7.58
T4	7.10	7.20	6.70	7.25	6.85	7.02
T5	7.70	7.85	7.65	7.35	7.50	7.61
T6	7.10	6.85	7.00	6.85	7.05	6.97
Sem	0.047	0.031	0.035	0.028	0.040	0.038
CD	0.146	0.095	0.109	0.087	0.123	0.117
CV	1.115	0.740	0.848	0.675	0.966	0.912
SIG	NS	S	S	S	S	NS

Texture: Maximum texture was found to be in treatment T3 (7.75) whereas minimum texture was found to be in treatment T1 (6.85). Results are supported by other works Hussain *et al*., (2006) [12].

Overall Acceptability: The maximum overall acceptability was found to be in treatment T5 (7.61) whereas minimum overall acceptability was found to be in treatment T4 (7.02). Overall acceptability was found to be significantly lower in wheat based cookies with the agreement of Padiyar (2010) [18].

Conclusion

In conclusion the results of this study indicate that, cookies were prepared with partial replacement of wheat flour by SRF that is 05, 10, 15, 20, and 25 per cent levels while other ingredients were kept constant. Results of study revealed that proximate *viz.* carbohydrates, protien, fat, energy value and amylose were decreased while fibre, ash, calcium, phosphorus, iron and moisture were increased. A result of organoleptic evaluation shows that overall acceptability of T5 with the score 7.61 was found bent among the rest treatments with supplementation of SRF up to 20%.

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