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Studies on physico-chemical parameters of biscuits using wheat, sorghum and groundnut blend flour

Rohit Kumar Maurya and Devendra Kumar

Biscuits are feasible to provide complete enrichment and contain different amount of protein, fat, mineral, carbohydrate and calorific energy. Experiments were conducted to evaluate quality attributes of biscuits using wheat, sorghum and groundnut blend flour. Study was also conducted to see the effect of blend flours treatments on physico-chemical parameters. Flours blend were prepared with various combination of wheat, sorghum and groundnut as W_{80}: S_{15}: G_{05} (T_1), W_{70}: S_{20}: G_{10} (T_2) and W_{60}: S_{25}: G_{15} (T_3). After preparation of biscuit physico-chemical properties *viz.,* moisture content, fat content, ash content, protein content and carbohydrate content were evaluated just fresh and after 30, 60 and 90 days of storage period. The study revealed that the moisture content increased with the increase of storage period for all treatments. The value of moisture content 4.76 per cent was obtained maximum in the treatment T_3 after 90 days of storage period. The ash content change with increase of storage period was slightly decreased in all treatments. The minimum ash content (0.88%) was found in the treatment T_3 after 90 days storage period. The fat content of biscuits sample decreased with increase in storage period in case of all treatments. Data obtained for protein content after 30, 60, 90 days of storage indicated that in case of all samples, the value decreased for all treatments. Highest protein content (13.5%) was observed in treatment T_3 for the fresh biscuits sample. Carbohydrate content was obtained minimum in T_3 (64.27%) at 0 day (fresh) and maximum in T_1 (66.48%) at 90 days. The average value was calculated for diameter and thickness as T_1 (40 mm) and (0.9 mm), T_2 (40 mm) and (0.9 mm), T_3 (40 mm) and (0.8 mm), respectively. There were no changes in diameter and thickness in different treatment of biscuits because ingredients were same in all treatments. The result showed that spread ratio was observed as 44.44, 44.44 and 50 for treatments T_1, T_2 and T_3, respectively. Fresh biscuit samples with wheat flour 70% + sorghum flour 20% + groundnut flour 10% (T_2) rated highest score (7.8) than other treatments.

Key Words : Biscuit, Blend flour, Physico-chemical, Spread ratio

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MEMBERS OF RESEARCH FORUM

Author for correspondence :
Rohit Kumar Maurya, Dr. Bhim Rao Ambedkar College of Agricultural Engineering and Technology, **Etawah (U.P.) India**
Email: rohitmaurya3131@gmail.com

Associate Authors' :
Devendra Kumar, Dr. Bhim Rao Ambedkar College of Agricultural Engineering and Technology, **Etawah (U.P.) India**
Email: devendrachaturvedi2008@gmail.com

INTRODUCTION

Some crops provide essential nutrients and energy in the human diet everyday through processed food consumption. Biscuits are prepared for gaining the nutrients and energy as to complete a daily requirement in a short time. Biscuits are feasible to provide complete enrichment. Biscuits contain a potential enrichment as

they are in different forms and flavor, have pleasant aroma and taste, and it can be consumed as snacks or integrant to other foods (Manley, 2005). Gandhi *et al.* (2001) reported that biscuits are widely popular in rural and urban region due to having a low cost along with pleasant taste, aroma and long shelf life. Biscuits contain different amount of protein, fat, ash, carbohydrate and calorific energy. Gani *et al*. (2015) reported that the biscuits contain low amount of protein around (7 – 10%) in it. Enriched nutritional biscuits may be prepared by using blend of wheat, sorghum and groundnut flour.

Wheat is a widely cultivated in worldwide and it is staple food (Shewry, 2009). Many species of wheat together make up the genus *Triticum*; the most widely grown is common wheat (*T. aestivum*). In India, wheat crops are cultivated in *Rabi* season. Wheat is an important source of carbohydrate. Wheat is a source of multiple nutrients and dietary fibre. Gluten – the major part of wheat protein. Wheat contains many nutrition and mineral composition and which fulfills as a daily energy requirement. Borron *et al.* (2007) stated that wheat grain contains 3% germ, 13-17% bran, 6-9% aleurone layer, 1% testa, 3-5% outer pericarp and 80-85% mealy endosperm (all constituents converted to a dry matter basis). According to USDA, total area under wheat crop in India during 2018-19 was 29.85 million hectares, and the production was 102.19 MT in 2018-19. Wheat contributes 11.6g protein, 2.0g fat, 71g carbohydrate, 2g crude fibre and 1.6g ash content per 100g edible portion (USDA, 2019).

Sorghum scientific name *Sorghum bicolor* (USDA Retrieved 2, 2016) and also called great millet. In India, sorghum popularly known as Jowar. Sorghum is one of the important food and fodder cereal crops. It is cultivated in both *Kharif* and *Rabi* season. It is reported about various food product of sorghum like preparation of extruded product (Youssef *et al.,* 1990), sorghum in pasta processing (Miche *et al.,* 1977), expanded snacks, cookies and ethic foods (Awika and Rooney, 2004) and 70% of sorghum production in India consumed as *Roti* (Murty and Subramanian, 2006). Sorghum contains 10.62g protein, 3.46g fat, 1.43g ash, 6.7g fibre, 72.09g carbohydrate and 329 kcal energy per 100g edible portion (USDA Food Data Central-2019). In India, sorghum grown mostly in central region. The state of Maharashtra is the leading producer of sorghum in the country. Other important producers of sorghum include states like Andhra Pradesh, Karnataka, and Tamil Nadu. According to FAOSTAT, 2020, total area under sorghum crop in India during 2018-19 was 5 million hectare and production was 4.5MT.

Groundnut also known as Peanuts (*Arachis hypogaea*) and it is the family of legumes, stated by (Bonku and Yu, 2019). According to USDA- Sorghum (2016), the groundnut also known as the peanut, earthnut, monkey nut, goober panda, and manilla nut. Groundnut content as nutrients such as protein, oil, fibre, vitamins and carbohydrate as compared to other types of nuts (Arya *et al.,* 2015). Protein content 20.7-25.3%, crude fat 31-46%, ash content 1.2-2.3%, crude fibre 1.4-3.9%, carbohydrate 21-37% and moisture content 4.9-6.8% were nutrient constituents of peanuts (Alhassan *et al.* 2017). The production of groundnut in 2018-19 was 6.89MT (FAOSTAT, 2020). Rajasthan is a leading wheat producer, followed by Gujarat and Maharashtra. Machewadi *et al.* (2006) studied on quality of chakli using sorghum-soybean-chickpea composite flour and reported that the blend of composite flour increased the amount of protein from 25.5 to 30.5%. Ozkaya *et al.* (2009) studied on technological properties of soft and hard variety of wheat during infested and found that gluten content and sedimentation value was decreased and protein and ash content was increased during period of storage. Masih *et al*. (2017) studied on Physico-chemical properties of biscuit influenced by different ratios of hydrogenated fat and peanut butter found that as increasing the proportion of peanut butter, fat content showed as decreased and was lowest in biscuits (50% peanut butter). Devi *et al.* (2018) studied on functional biscuits with wheat flour, soy flour and banana rhizome starch and found that nutrient of biscuits was according to treatments. T_4 treatment had maximum protein content (16.90%) and fat content was maximum (21.59%) whereas T_5 treatment had maximum moisture content (4.00%) and ash content was maximum (1.55%).

The relation between food and health has an increasing impact on food innovation, due to the popularity of the concept of functional food. The practice of using nutrition knowledge at the food product level to improve health of the consumer forms the general concept of functional foods. Good qualities of wheat, sorghum and groundnut composite flour produce biscuits with high nutrient value and minerals content, uniformity in shape, light crust colour, crispness, pleasant taste, smooth texture.

Therefore, the study was undertaken to evaluate quality attributes such as physico-chemical parameters of developed biscuits.

METHODOLOGY

Wheat flour was prepared by taken 2 kg wheat grains that grains were sorted, cleaned, washed in cooled water by manually, drained the water, kept for tempering under room temperature for 10 – 12 hours and then dry under sunlight for 24-36 hours in only day time. The dried grains was milled when moisture content is about 7-10% in an attrition milling machine to obtain the flour by sieving using a sieve with 300µm aperture and then kept in an air-tight HDPE film package until ready for further use.

Sorghum flour was prepared by taken 2 kg sorghum grains that grains were sorted, cleaned, washed in cooled water by manually and steeped for 6 hours to attained 42-45 % moisture level. Grains was kept in aluminum tray and then kept in tray drier machine at 60° C for until moisture level came down 10 – 12 %. Dried grains was milled in an attrition milling machine to obtain the flour by sieving using a sieve with 300µm aperture and then kept in an air-tight HDPE film until ready for further use.

Groundnut flour was prepared by taken 1 kg raw peanut. It was cleaned and sorted by hand. Raw peanut was roasting at 60° C for 60-75 minutes in common salt. Dehulled a roasted peanut by manually. Roasted peanuts milled in grinder machine, due oil content in it becomes as paste form and then it kept in hot air oven for drying at 120° C at least 2-3 hours until dried and then kept in an air-tight HDPE film until ready for further use.

The study was undertaken to develop biscuits using the blend of wheat, sorghum, and wheat flour and its qualitative analysis was done during various storage period at room temperature (around 30° C) and relative humidity 70% - 80%. Flours blend were prepared with various combination of wheat, sorghum and groundnut. Based on the nutritional analysis of freshly made biscuits, the most preferred treatment were selected as T_1- W_{80}: S_{15}: G_{05}, T_2- W_{70}: S_{20}: G_{10}, T_3- W_{60}: S_{25}: G_{15}.

For development of biscuits, firstly measured all ingredients accurately. As per the process of making biscuits, initially mixed ingredients (milk, *Ghee*, sugar and baking powder) to make soft paste by rough rubbing for atleast 15 minutes. After that mixed a flour one by one on soft paste of ingredients and kneaded materials properly for 15-20 minutes. Once kneading completed, then it rolled, smooth and flat liked as chappti. Cut biscuit pieces as a desired shape and kept in aluminum tray. Now it ready for to baked biscuits, so biscuit pieces kept along with aluminum tray in baking oven machine, when temperature of inside oven at $+170^0$C, with a proper precaution keep the tray in baking oven machine and closed for 13 to 15 minutes, until biscuits become golden brown colour. Take out from machine and keep it for cooling alteast 30 minutes. After-that cooled biscuits were pack in polythene coated aluminum film. Biscuit packets were stored at a room temperature for further experimentation.

Weighing of samples for analysis of moisture content fat content, ash content, protein content and carbohydrate was carried out with the help of electronic balance. Moisture content of samples was determined by the method of moisture AOAC (2005). Fat content was determined by the method of fat AOAC (2003) by soxhlet extraction. Ash content was determined by the method of AOAC (2000) by muffle furnace. Protein content was determined by AOAC (2000) - Micro-kjeldahl method. The spread ratio of biscuits was calculated by dividing of the average value of diameter of biscuits by the average value of thickness of biscuits.

OBSERVATIONS AND ASSESSMENT

The study was undertaken to develop biscuits using the blend of wheat, sorghum, and wheat flour and its qualitative analysis was done during various storage period at room temperature. For the evaluation of quality of biscuits, several physico-chemical parameters *viz.,* moisture content, fat content, ash content, protein content, carbohydrate content were evaluated just fresh and after 30, 60 and 90 days of storage period. Diameter, thickness and spread ratio of biscuits were also determined.

Results showed that the samples prepared with blend flour as T_1, T_2 and T_3 had moisture content of 4.70%, 4.67% and 4.31% on fresh biscuits, respectively. The moisture content was increased with increase of storage period in all treatment (Fig. 1). Similar increasing trends were also observed by Kumar *et al*. (2016). Moisture content was obtained minimum in T_3 (4.31%) at 0 day (fresh biscuit) and maximum in T_1 (4.76%) at 90 days. During storage period, changes in moisture content was observed in T_1 (4.70% to 4.76%), T_2 (4.67% to 4.71%) and T_3 (4.31% to 4.37%) as shown in Table 1. The ash content was observed slightly decreased with increase

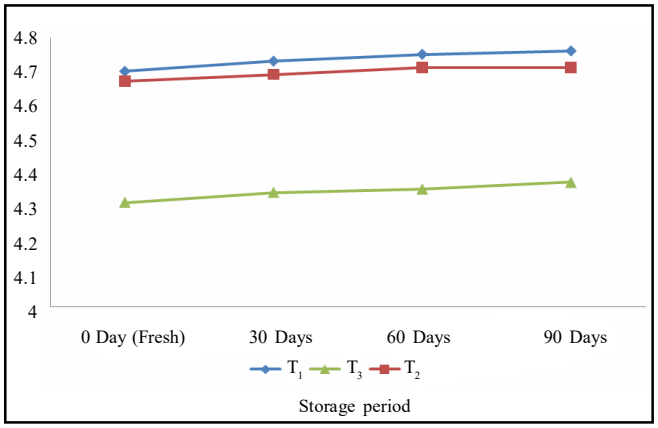

Fig. 1 : Changes in moisture content (%) in all treatment during storage periods

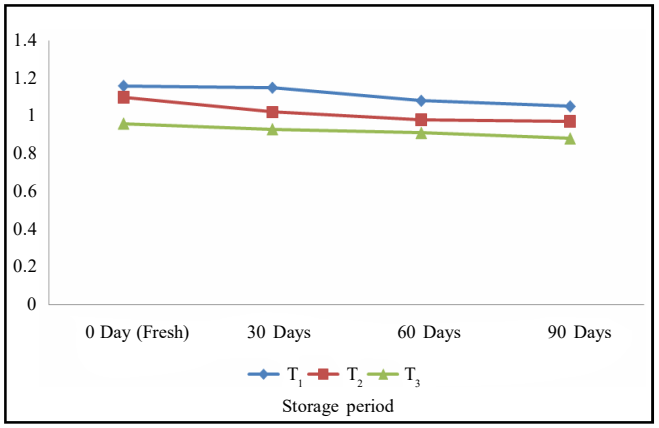

Fig. 2 : Changes in ash content (%) in all treatment during storage periods

of storage period in all treatments of blend flour biscuits. Results showed that ash content was decreased in the treatment (T_1, T_2, and T_3), respectively (Fig. 2). Ash content was obtained minimum in T_3 (0.88%) at 90 days and maximum in T_1 (1.16%) at 0 day (fresh). During storage period, changes in ash content were obtained in T_1 (1.16% to 1.05%), T_2 (1.10% to 0.97%) and T_3 (0.96% to 0.88%) as shown in Table 1. The fat content was observed slightly increased in treatments as 15.59%, 16.26% and 16.95% in T_1, T_2 and T_3, respectively in fresh samples of biscuit. Results showed that fat content was decreased with increased in storage period (Fig. 3). Due to auto-oxidation of unsaturated fatty acids during storage are the main reasons for reduction of fat content in food product O'Brien *et al.* (2003). Fat content was observed minimum in T_1 (15.55%) at 90 days and maximum in T_3 (16.95%) at 0 day (fresh). During storage period, changes in fat content were shown in T_1 (15.69% to 15.55%), T_2 (16.26% to 16.08%) and T_3 (16.95% to 16.75%) as shown in Table 1. Protein content of samples prepared with blend flour as T_1, T_2 and T_3 obtained as 12.23%, 12.87% and 13.51%, respectively in fresh samples of

Table 1: Change in physico-chemical parameters in biscuits during different storage period at room temperature

Parameters	Treatments	Storage period			
		Fresh	30 days	60 days	90 days
Moisture content (%)	W_{80}: S_{15}: G_{05} (T_1)	4.70	4.73	4.75	4.76
	W_{70}: S_{20}: G_{10} (T_2)	4.67	4.69	4.71	4.71
	W_{60}: S_{25}: G_{15} (T_3)	4.31	4.34	4.35	4.37
Ash content (%)	W_{80}: S_{15}: G_{05} (T_1)	1.16	1.15	1.08	1.05
	W_{70}: S_{20}: G_{10} (T_2)	1.10	1.02	0.98	0.97
	W_{60}: S_{25}: G_{15} (T_3)	0.96	0.93	0.91	0.88
Fat content (%)	W_{80}: S_{15}: G_{05} (T_1)	15.69	15.60	15.56	15.55
	W_{70}: S_{20}: G_{10} (T_2)	16.26	16.20	16.10	16.08
	W_{60}: S_{25}: G_{15} (T_3)	16.95	16.87	16.80	16.75
Protein content (%)	W_{80}: S_{15}: G_{05} (T_1)	12.23	12.19	12.19	12.16
	W_{70}: S_{20}: G_{10} (T_2)	12.87	12.80	12.77	12.71
	W_{60}: S_{25}: G_{15} (T_3)	13.51	13.43	13.39	13.33
Carbohydrate Content	W_{80}: S_{15}: G_{05} (T_1)	66.22	66.33	66.42	66.48
(%)	W_{70}: S_{20}: G_{10} (T_2)	65.10	65.29	65.44	65.53
	W_{60}: S_{25}: G_{15} (T_3)	64.27	64.43	64.55	64.67

T_1- 80% wheat flour + 15% sorghum flour + 05% groundnut flour (W_{80} : S_{15} : G_{05}),
T_2- 70% wheat flour + 20% sorghum flour + 10% groundnut flour (W_{70} : S_{20} : G_{10}),
T_3- 60% wheat flour + 25% sorghum flour + 15% groundnut flour (W_{60} : S_{25} : G_{15}).

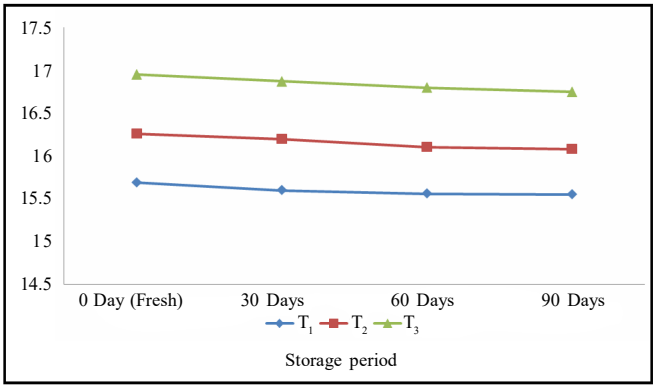

Fig. 3 : Changes in fat content (%) in all treatment during storage periods

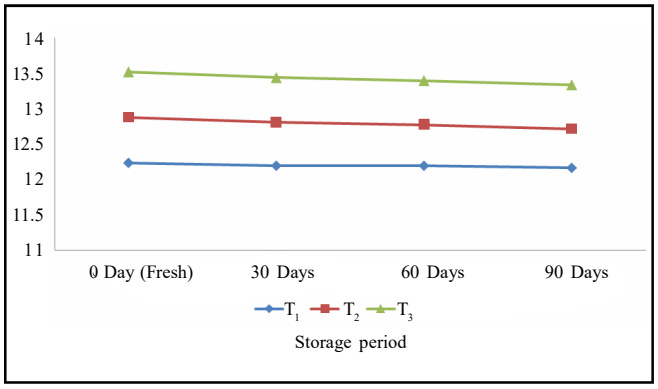

Fig. 4 : Changes in protein content (%) in all treatment during storage periods

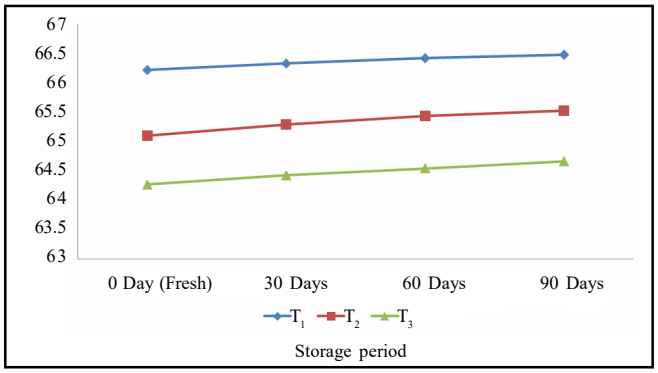

Fig. 5 : Changes in carbohydrate content (%) in all treatment during storage periods

biscuit. Finot (1997) reported that during storage period, there is loss of amino acids which result as Millard reaction. Millard reaction makes the loss of protein stability (Fennema, 1996). Results showed that protein content was decreased with increase of storage period. Protein content was observed minimum in T_1 (12.16%) at 90 days and maximum in T_3 (13.51%) at 0 day (fresh). During storage period, changes in protein content were shown 12.23% to 12.16% in T_1, 12.87% to 12.71% in T_2 and 13.51% to 13.33% in T_3 treatment of blend flour (Table 1). Fig. 4 shows changes in protein content in all treatment during storage period. Carbohydrate content was observed as 66.22%, 65.10% and 64.27% in T_1, T_2, and T_3 treatments, respectively in fresh samples of biscuit. Results showed that carbohydrate content was increased with increase in storage period. Carbohydrate content was obtained minimum in T_3 (64.27%) at 0 day (fresh) and maximum in T_1 (66.48%) at 90 days. During storage period, changes in carbohydrate content were observed 66.22% to 66.48% in T_1, 65.10% to 65.53% in T_2 and 64.27% to 64.67% in T_3 treatments of blend flour (Table 1). Similar range of carbohydrate was also reported by Elemo *et al.* (2011). Fig. 5 shows changes in carbohydrate content in all treatment during storage period. The diameter and thickness was observed as T_1 (40 mm) and (0.9 mm), T_2 (40 mm) and (0.9 mm) and T_3 (40 mm) and (0.8 mm), respectively. There were no changes in diameter and thickness in different treatment of biscuits because ingredients were same in all treatments. While baking biscuits the shape were given same in all treatments as in form of circle. The result showed that spread ratio was found 44.44, 44.44 and 50 for T_1, T_2 and T_3 biscuit sample, respectively. Biscuits spread ratio was the test characterizing the biscuits baking properties depending on the value of the biscuit diameter and thickness.

ANOVA were generated for all physico-chemical parameters (moisture content, fat content, ash content, protein content and carbohydrate content) which were significant at 5 per cent level.

Conclusion:

Experiments were conducted to evaluate quality attributes of biscuits using wheat, sorghum and groundnut blend flour. On the basis of investigation, it is concluded that, flours blend prepared with combination of wheat, sorghum and groundnut as 70% wheat flour + 20% sorghum flour + 10% groundnut flour (T_2) rated highest score (7.8) than other treatments. The moisture content was increased with increase of storage period in all treatment. Moisture content was obtained minimum in T_3 (4.31%) at 0 day (fresh biscuit) and maximum in T_1 (4.76%) at 90 days. The ash content changes with

increase of storage period were slightly decreased in all treatments of blend flour biscuits. Ash content was obtained minimum in T_3 (0.88%) at 90 days and maximum in T_1 (1.16%) at 0 day (fresh). The fat content was observed slightly decreased in treatments during storage period. Fat content was observed minimum in T_1 (15.55%) at 90 days and maximum in T_3 (16.95%) at 0 day (fresh). Protein content was decreased with increase of storage period. Protein content was observed minimum in T_1 (12.16%) at 90 days and maximum in T_3 (13.51%) in fresh biscuits. Carbohydrate content was increased with increase in storage period. Carbohydrate content was obtained minimum in T_3 (64.27%) in fresh biscuits and maximum in T_1 (66.48%) at 90 days.

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