International Conference on Recent Trends in Agriculture, Food Science, Forestry, Horticulture, Aquaculture, Animal Sciences, Biodiversity, Ecological Sciences and Climate Change (AFHABEC-2017)

Development and Evaluation of Gluten Free Biscuits by Incorporation of Mahua Powder as Natural Sugar

Priyanka Ravat*[1] and Ashish Dixit[2]

[1]School of Vocational Studies & Applied Sciences, GBU, Greater Noida (UP), India
[2]G.N. Patel College of Dairy Science and Food Tech., SDAU, Sardarkrushinagar (Gujarat), India

Abstract—*Studies were conducted to develop gluten free biscuits by the incorporation of mahua powder with gluten free composite flour of soybean and ragi in different proportions (T_1=10:55:35, T_2=20:35:55, T_3=30:35:35, T_4=40:30:30, T_5=50:25:25, T_6=60:10:30, T_7=70:15:15). The physico - chemical properties of developed gluten free biscuits were studied. Shelf-life study was also carried out for 60 days. Increase in concentration of mahua powder (10-40 %) resulted in gluten free biscuits with increased diameter, thickness and spread ratio during baking while these properties were found decreased with further increased concentrations (40-70 %) of mahua powder. On the basis of overall physico-chemical and sensory properties, sample T_4 and T_5 showed maximum acceptability.*

Keywords*: Gluten free biscuit, mahua powder, natural sugar, shelf-life study.*

1. INTRODUCTION

Nowadays biscuit becomes more popular in India among ready-to-eat snacks due to various characteristics including relatively longer shelf-life, more convenience and good eating quality [9]. According to Fayemi (1999), biscuit is defined as small thin crisp cake made from unleavened dough, containing high percentage of fat and sugar.

Celiac disease is an autoimmune disorder characterized by intolerance to gluten [7]. It is considered to be a potentially significant cause of poor health in population. This chronic disease is recognized as long-life disease and the only solution is the gluten-free products.

Soybean flour is rich in protein content, lowers the risk of blood cholesterol. Soy proteins are also of the highest quality amongst all legumes. Soybean flour reduces the risk of chronic diseases like diabetes, artherosclerosis, osteoporosis and cancer due to the presence of nutraceutical ingredients [5]. Soybean is rich in Lysine in compare to other grains. Soybean flour provides sufficient amount of dietary fiber and contains many minor substances like calcium, magnesium, iron, niacin, riboflavin, with several fats.

Ragi (Finger Millet) is mainly used as staple food in India. It is rich in fiber, calcium, iron, protein and other minerals. Ragi has low fat content and mainly contains unsaturated fat. It is an excellent supplement for aging people and growing children because of calcium. It is

ISBN: 978-93-85822-44-5

helpful in bringing down the cholesterol level because of having lecithin and methionine content. Because of its higher content of fiber, it is easy to digest and does not contain gluten. Ragi contains number of essential amino acids viz. tryptophan, valine, methionine, theronine and isoleucine. Tryptophan lowers appetite and helps in keeping weight in control [3], Isolucine helps in repairing muscle, blood formation, improves skin health and contributes to bone formation, valine facilitates metabolism and helps in muscle coordination.

Mahua (Madhuca indica) belonging to the family Sapotaceae [4]. Mahua flowers are rich in reducing sugar and nutrient content. They are used as a sweetener in preparation of Indian traditional dishes [11]. Fructose sugar is found in mahua flower. Apart from rich source of sugar and protein, the flower contains essential minerals like calcium, phosphorus and Iron. Riboflavin and niacin content is also present in mahua flower.

The present investigation was carried out for the development and evaluation of gluten free biscuits by incorporation of mahua flower as natural sugar. The physico-chemical parameters and storage period of developed gluten free biscuits were also studied.

2. MATERIAL AND METHODS

The experimental study was carried out in the Department of Food Processing & Technology, Gautam Buddha University, Greater Noida, Uttar Pradesh, India. Soybean, ragi flour, Mahua and other ingredients like butter, baking soda, baking powder, milk powder and salt were procured form the local market of Greater Noida. Xantham gum was procured from the by Himedia Laboratories Pvt. Ltd, Mumbai, India. Xantham gum was collected from the laboratory of Gautam Buddha University, Greater noida.

2.1 Physico-chemical analysis of raw material

Moisture content of raw material was determined by hot air oven method (AOAC,1995) [2]. Ash content, fat content and protein content were determined by muffle furnace, soxhlet method, and micro-kjeldhal method, respectively [13]. Fiber was determined as crude fiber according to standard method described in AOAC (1995) [2]. Sedimentation value and water absorbing power of flour was also determined by methods described in Ranganna 1994.

2.2 Preparation of mahua powder

Firstly, fresh mahua were cleaned with water and mahua were spread in trays evenly to remove excess water for about 1 hour. Then mahua were put in mechanical drier at 33-35^{o}C till the 9-10% moisture level reached. After drying, mahua were roasted for about 5 minutes then cooled. Then mahua were ground into powder in a grinder. The mahua powder was then sieved and packaged in pre sterilized polyethylene bags and stored at room temperature for further preparation of biscuits.

2.3 Preparation of composite flour

The composite flour was prepared by using certain proportions of soybean and ragi flour with mahua powder as given in table 1.

ISBN: 978-93-85822-44-5

Table 1: Proportion of composite flour (Soybean & Ragi flour) and mahua powder

Treatment	Soybean flour (%)	Ragi flour (%)	Mahua powder (%)
T1	55	35	10
T2	33	55	20
T3	35	35	30
T4	30	30	40
T5	25	25	50
T6	10	30	60
T7	15	15	70

2.4 Preparation of mahua powder

Mahua powder was prepared according to flow diagram given below (Fig. 1)

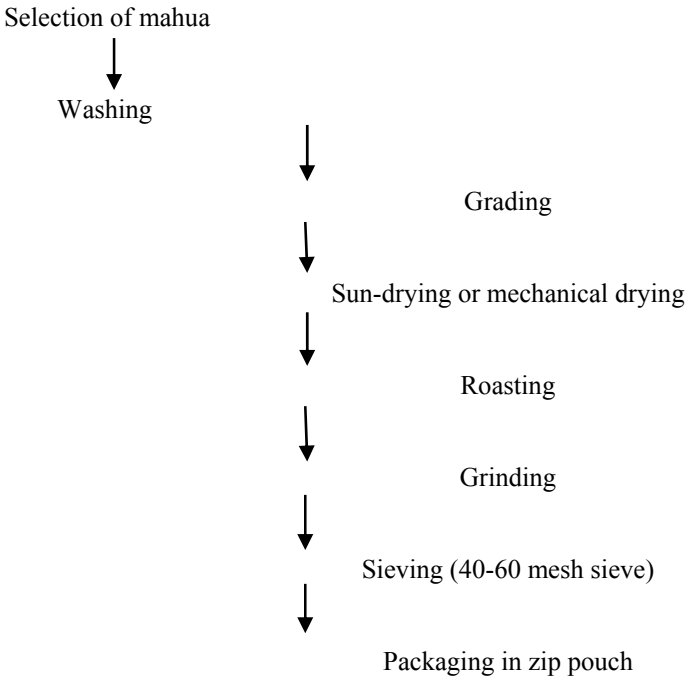

Fig. 1 Process flow sheet for development of mahua powder

ISBN: 978-93-85822-44-5

2.5 Preparation of biscuits

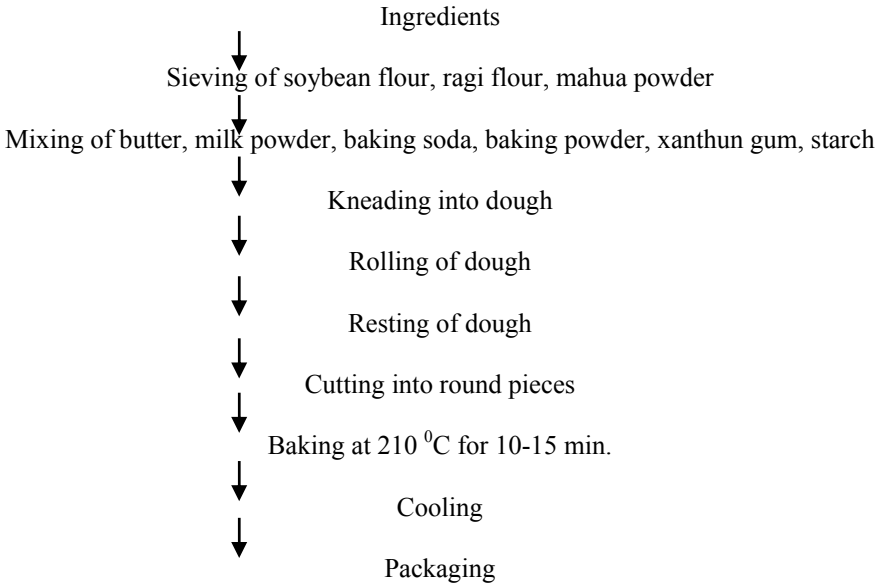

Fig. 2 Process flow sheet for development of buiscuit

2.6 physical properties of biscuit

Expansion in diameter and thickness was the ratio of biscuit diameter and thickness before and after baking. Spread ratio of biscuit samples was calculated as per standard AACC methods [1]. All experiments of the study were performed in triplicate.

2.7 Sensory Evaluation

Sensory evaluation for the colour, texture, taste, odour and overall acceptability were done to determine consumer acceptability. A numeric hedonic scale ranging from 1 to 9 was used for sensory evaluation by a panel of judges.

3. RESULTS AND DISCUSSION

3.1 Chemical analysis of gluten free biscuit

The moisture content increases as the percentage of mahua increases in biscuits (Table 2). The slight changes were found in ash content in different samples. The percentage of fat, protein content and reducing sugar gradually increases as the quantity of mahua powder increases. Rich protein content indicates the improvement in nutrients, high content of crude fiber helps in digestion and high reducing sugar helps in problem related to diabetes and high level of blood cholesterol. The percentage of acid insoluble ash slightly changes in different samples. These results show the potential of mahua flowers to be used as a novel source of natural sweetener.

ISBN: 978-93-85822-44-5

Table 2: Physico- chemical analysis of gluten free biscuit

No. of Treatments	Moisture %	Ash %	Fat %	Protein %	Crude Fibre %	Reducing sugar %
T_1	4.6	3.9	6.41	14.62	4.45	1.5
T_2	4.8	3.9	6.67	15.89	4.4	2
T_3	4.8	3.86	6.67	16.12	4.56	2.5
T_4	5.2	3.86	6.67	16.44	4.76	3
T_5	5.4	3.86	6.69	17.68	4.93	3.5
T_6	5.8	3.84	6.77	17.89	4.98	4
T_7	5.8	3.83	6.79	17.99	4.99	4.5

3.2 Analysis of physical properties of gluten free biscuit

Physical properties of gluten free biscuit were calculated on the basis of diameter, thickness and spread ratio. The measured values are shown in table 3. The diameter, thickness and spread ratio of baked biscuits at different treatments were found change during baking at temperature 210°C for 10-15 min. The values of diameter, thickness and spread ratio of T_6 and T_7 samples are less in comparison to T_1, T_2, T_3, and T_4 samples. It might be due to the highest percentage of mahua powder.

Significant reduction in expansion in diameter with increasing levels of mahua powder in all samples of biscuits was found. It might be due to increased fiber content in the samples, which affected the expansion in the diameter of biscuit samples. Similar trend in expansion in diameter was observed in biscuits with carrot and beetroot powder [10 &11].

Studies indicated that the crude fiber of the biscuit formulations affected the thickness development during cooking [6 &11]. Significant effect of different levels of ragi, soy and mahua powder was also observed in the spread ratio of biscuits due to the different ingredients characteristics.

Before baking, the thickness and diameter of biscuit was 4.4 and 5.5 cm, respectively but after baking increased results were found.

Table 3: Physical properties of gluten free biscuit

No. of Treatments	Diameter	Thickness	Spread Ratio
T_1	5.9	4.6	1.28
T_2	5.9	4.7	1.25
T_3	5.9	4.7	1.25
T_4	6	4.8	1.22
T_5	6	4.7	1.22
T_6	5.8	4.6	1.26
T_7	5.8	4.5	1.26

3.3 Changes in physico -chemical properties of gluten free biscuit during storage

Table 4 shows the changes on moisture content of developed gluten free biscuits during storage. It was observed that moisture content of all samples increases with increased time period. The percent moisture content for T_1, T_2, T_3, T_4, T_5, T_6 and T_7 was observed in the range of 4.6 - 6.2, 4.8 - 6.2, 4.8- 6.6, 5.2- 6.6, 5.4 - 7.2, 5.8 - 7 and 5.9 -7, respectively during 0 to 60 days. Sample T_5, T_6 and T_7 shows highest moisture content in samples during storage

ISBN: 978-93-85822-44-5

period. The ash content in the food stuff represents inorganic matters remaining after the organic matters have been burnt. The percent ash content for T_1, T_2, T_3, T_4, T_5, T_6, and T_7, was observed in the range of 3.9- 3.86, 3.9- 3.86, 3.86- 3.84, 3.86- 3.84, 3.86- 3.82, 3.84- 3.82, 3.89- 3.87, respectively. No significant changes observed in the ash content of different samples during the storage period of 60 days (Table 5). No significant changes observed in the fat content of different samples during the storage period of 60 days (Table 6). The percent fat content for T_1, T_2, T_3, T_4, T_5, T_6 and T_7 was observed in the range of 6.49 - 6.67, 6.53 - 6.67, 6.59 - 6.70, 6.62 - 6.78, 6.62 - 6.77, 6.46 - 6.76 and 6.79 - 6.88, respectively during 0 to 60 days.

Table 4: Effect on moisture content of gluten free biscuit during storage

No. of Treatment	Storage Period						
	0 Day	10 Days	20 Days	30 Days	40 Days	50 Days	60 Days
T_1	4.6	4.8	4.8	5	6.2	6.4	6.2
T_2	4.8	4.8	4.8	5	6.2	6.4	6.2
T_3	4.8	4.8	4.8	5	6.6	6.6	6.6
T_4	5.2	5.6	5.2	5.2	6.8	7.6	6.6
T_5	5.4	5.4	5.4	5.4	7.2	7.6	7.2
T_6	5.8	5.8	5.8	5.8	7.4	7.8	7
T_7	5.9	5.9	5.9	6.8	7.4	7.8	7

Table 5: Effect on ash content of gluten free biscuit during storage

No. of Treatment	Storage Period						
	0 Day	10 Days	20 Days	30 Days	40 Days	50 Days	60 Days
T_1	3.9	3.86	3.88	3.88	3.88	3.86	3.86
T_2	3.9	3.86	3.88	3.88	3.88	3.86	3.86
T_3	3.86	3.84	3.84	3.88	3.86	3.84	3.84
T_4	3.86	3.84	3.84	3.84	3.84	3.82	3.84
T_5	3.86	3.84	3.84	3.84	3.84	3.80	3.82
T_6	3.84	3.84	3.81	3.84	3.84	3.80	3.82
T_7	3.89	3.80	3.88	3.86	3.82	3.85	3.87

Table 6: Effect on fat content of gluten free biscuit during storage

No. of Treatment	Storage Period						
	0 Day	10 Days	20 Days	30 Days	40 Days	50 Days	60 Days
T_1	6.49	6.50	6.51	6.45	6.56	6.61	6.67
T_2	6.53	6.66	6.66	6.66	6.74	6.66	6.67
T_3	6.59	6.66	6.54	6.66	6.68	6.69	6.70
T_4	6.62	6.72	6.67	6.67	6.70	6.75	6.78
T_5	6.62	6.66	6.68	6.68	6.70	6.69	6.77
T_6	6.46	6.52	6.78	6.76	6.77	6.70	6.76
T_7	6.79	6.80	6.84	6.79	6.77	6.89	6.88

ISBN: 978-93-85822-44-5

4. CONCLUSION

The studies were conducted for the development and evaluation of gluten free biscuits by incorporation of mahua as natural sugar. Seven treatment were conducted (i.e. 50:50:0, 55:35:10, 35:55:20, 35:55:30, 30:30:40, 25:25:50, 10:30:60, 15:15:70). The sample T_4 and T_5 found satisfactory after testing of physical, chemical, sensory and shelf-life studies of biscuit. Biscuit sample were found 2 month of shelf life on ambient temperature with LDPE packaging.

Different sensory attributes like color, flavor, taste, texture and over all acceptability were performed. During shelf life study finally Sample T_6 and T_7 was found significantly difference in their taste, flavor, color change to store for a period of up to 60 days of shelf life study.

Thus these gluten free biscuits can be recommended for the people suffering from celiac disese and diabetes.

REFERENCES

[1] AACC (1967) Approved method of American Association of Cereal Chemists. Cereal Laboratory Methods, St. Paul.

[2] A.O.A.C. (1995)**.** Official method of analysis. 12th edn. Association of official analytical chemist, Washington, DC.

[3] Arya, J. (2014). Food is your Medicine, Published by Dr. Arya Publications, Pune.

[4] Banerji, R. and Mitra, R., (1996). Mahua (Madhuca species): uses and potential in India. Appl. Bot. Abstract, 16, 260-77

[5] Bhatnagar S, Gupta SD, Mathur M, Phillips AD, Kumar R, Knutton S, Unsworth DJ, Lock RJ, Natchu UC, Mukhopadhyaya S, Saini S, Bhan MK (2005). Celiac disease with mild to moderate histologic changes is a common cause of chronic diarrhea in Indian children. *J Pediatr Gastroenterol Nutr* 41:204–209.

[6] Brennan, C.S. and Samyue, E. (2004). Evaluation of starch degradation and textural characteristics of crude fibre enriched biscuits. *Int. J. Food Properties*, 7(3): 647-657.

[7] Demirkesen, I., Sumnu, G. and Sahin, S. (2013) Quality of gluten-free bread formulations baked indifferent ovens. *Food and Bioprocess Technology*, 6: 746-753.

[8] Feyemi, P.O. (1999). Nigerian Vegetables. Heinemann Educational Book (Nig) Plc, p p. 94-95.

[9] Hooda, S. and Jood, S. (2005). Organoleptic and nutritional evaluation of wheat biscuits supplemented with untreated and treated fenugreek flour. Food Chemistry 90:427–435.

[10] Mridula, D., Gupta, R.K. and Manikantan, M.R. (2007). Effect of incorporation of sorghum flour to wheat flour on quality of biscuits fortified with defatted soy flour. *Am. J. Food Technol*., 2(5): 428-434.

[11] Mridula D (2011) Physico-chemical and sensory characteristics of β-carotene rich defatted soy fortified biscuits*. Afr J Food Sci.* 5(5):305–312.

[12] Patel, M. and Naik, S.N. (2008). Biochemical investigations of fresh mahua (Madhuca Indica) flowers for nutraceutical. PhD. Thesis, Centre for Rural Development and Technology, Indian Institute of Technology, New Delhi, India.

[13] Ranganna, S. (1999). Handbook of analysis and quality control for fruits and vegetable products, 2nd edition. Tata McGraw Hill, New Delhi.

ISBN: 978-93-85822-44-5