Development And Evaluation Of High Protein And Low Gluten Biscuits

G SUSHMITHA
M.Tech (Food Technology)
University College of Technology
Osmania University
Hyderabad, T.S, India.

SRINIVAS MALOO
Associate Professor (Food Technology)
University College of Technology
Osmania University
Hyderabad, T.S, India.

NAYANALA BABU
DY Manager (Q.C Lab),
Telangana Foods,
I.D.A., Nacharam,
Hyderabad, T.S, India.

RAMU GOLLA
Senior Lab Chemists,
Telangana Foods,
I.D.A., Nacharam,
Hyderabad, T.S, India.

V BHASKER
Assistant Professor (Food Technology),
University College of Technology,
Osmania University,
Hyderabad, T.S, India

Abstract: **The present study was conducted for the purpose to provide high protein and low gluten biscuits to children's. First by substituting wheat flour with finger millet and soy bean flour formulation was standardized to make low gluten biscuits. To the standardized biscuits formula whole egg was added up to acceptable limit to make high protein and low gluten biscuits. The biscuits prepared were analyzed for chemical, mineral, physical analysis and sensory characteristics. From those results best samples C- (100% refined wheat flour), T5- (wheat flour (20%), finger millet flour (40%), soy bean flour (40%)) and T9- (wheat flour (20%), finger millet flour (40%), soy bean flour (40%), whole egg (40%)) has been selected for shelf life studies. The sensory parameters in control sample were decreased from initial to 90th day. Similarly the sensory parameters in T5 and T9 sample were also decreased from initial to 90th day. The results revealed that there was statistically significant increase in the mean moisture content of biscuits from 0th day to 90th day of storage period. The peroxide value of biscuits on 0th day and 90th day of storage was 5.53±0.14 meq/kg, 5.92±0.09 meq/kg,5.90±0.12 meq/kg and 6.05±0.06 meq/kg, 6.42±0.11 meq/kg, 6.55± meq/kg for the control, T5 and T9 respectively. In biscuits the microbial count such as total bacterial count and total fungal count was observed on 0th, 30th, 60th and 90th day.**

Keywords: **Standardization; Sensory Evaluation; Whole Egg; Finger Millet; Soybean;**

I. INTRODUCTION

This research was conducted to reduce the Protein-Energy Malnutrition (PEM) of the children's through the development of biscuits, enriched with egg, finger millet flour and soybean flour to increase protein nutrient consumption in human diet. Children who do not take well nutrition diet are the main beneficiary of egg. Taking an egg fulfils their stomach and keeps energized, thus maintaining a healthy weight. Teenagers who skip meals often may miss vital nutrients in their daily diet. They are advised to take eggs or egg containing products to replace the nutrients and to avoid nutritional deficiencies. Eating raw or half-boiled eggs may cause food poisoning due to bacteria. Boiled eggs or egg containing foods are safe for all types of body. A study was planned to develop biscuits incorporated with whole egg. So that eggs given to children's can be replaced with whole egg incorporated biscuits. In addition to whole egg the finger millet and soybean flours are substituted with refined wheat flour to reduce gluten content and to increase protein content of biscuits.

According to NIDDK (2008), the only treatment for celiac disease is a gluten-free diet. If you avoid gluten, your small intestine will heal. If you eat gluten or use items that contain gluten, celiac disease will continue to harm your small intestine.

Complete avoidance of gluten enables the intestine to heal, and the nutritional deficiencies and other symptoms to resolve. Children tend to heal more quickly than adults. Going gluten-free does not mean that you are cutting a vital nutrient out of your diet. And a gluten-free diet is not inherently unhealthy. But going gluten-free doesn't automatically mean that you are eating a more nutrient-dense diet either. It matters what you replace those wheat. In the present study finger millet and soybean flours were used to replace wheat.

II. MATERIALS AND METHODS

2.1 Preparations of ingredients

Finger millets and soybeans were thoroughly cleaned by removing dust, dirt and admixture of other grains. The cleaned finger millets and Soybeans were roasted until light brown. The roasted finger millets and soybeans were ground in a domestic grinder (Philips). The finger millet and soy bean flours were sieved through a 100-150 mesh sieve. The samples were kept in airtight container until used.

2.2 Standardization and development of biscuits

The high protein and low gluten biscuits were developed by incorporation of whole egg, finger millet flour and soybean flour at different levels. Products without the addition of whole egg, finger millet flour and soybean flour served as a control. First by substituting refined wheat flour with finger millet and soybean flour the formulation was standardized to make low gluten biscuits. To the standardized biscuits formula whole egg was added up to acceptable limit to increase protein content in biscuits to make high protein and low gluten biscuits. Whole egg was added in formulations to provide egg nutritional values to children's in the form of ready to eat snack food. Ten variations were formulated by incorporating whole egg, finger millet flour and soybean flour. First finger millet and soybean flours levels were optimized to the acceptable limit based on sensory evaluation then whole egg was substituted in place of water and fat used for making dough.

2.2.1 Treatments for development of biscuits

Control: Biscuits made by 100% wheat flour (refined), sugar (30%), fat (30%), water (40%).

T1: Refined wheat flour (80%), finger millet flour (20%), sugar (30%), fat (30%) and water (40%).

T2: Refined wheat flour (60%), finger millet flour (40%), sugar (30%), fat (30%) and water (40%).

T3: Refined wheat flour (50%), finger millet flour (50%), sugar (30%), fat (30%) and water (40%).

T4: Refined wheat flour (40%), finger millet flour (40%), soybean flour (20%), sugar (30%), fat (30%) and water (40%).

T5: Refined wheat flour (20%), finger millet flour (40%), soybean flour (40%), sugar (30%), fat (30%) and water (40%).

T6: Refined wheat flour (10%), finger millet flour (40%), soybean flour (50%), sugar (30%), fat (30%) and water (40%).

T7: Refined wheat flour (20%), finger millet flour (40%), soybean flour (40%), whole egg (20%), sugar (30%), fat (30%) and water (20%).

T8: Refined wheat flour (20%), finger millet flour (40%), soybean flour (40%), whole egg (30%), sugar (30%), fat (30%) and water (10%).

T9: Refined wheat flour (20%), finger millet flour (40%), soybean flour (40%), whole egg (40%), sugar (30%), fat (30%).

T10: Refined wheat flour (20%), finger millet flour (40%), soybean flour (40%), whole egg (50%), sugar (30%) and fat (20%).

2.3 Physical analysis of biscuits

- Diameter (D**)** - The diameter of biscuits was measured by laying six biscuits edge-to-edge and measuring to the nearest cm (AACC, 1967).The biscuits were rotated at 90° and their diameter was re-measured as a check determination. The average value was reported in cm.
- Thickness (T**)** - Thickness or height of the biscuits was measured by stacking six biscuits one above the other and the average value was expressed as cm (AACC, 1967).
- Spread ratio (SR) - The spread ratio was calculated by dividing the average value of diameter (D) by the average value of thickness (T) of biscuits (AACC, 1967).
- Per cent spread factor (SF)**-** The per cent spread factor was calculated by the following formula:

$$\% SF = \frac{\text{SR of biscuits prepared from blend}}{\text{SR of biscuits prepared from control}} \times 100$$

2.4 Evaluation of chemical analysis of biscuits

The nutritional values like moisture, protein, fat, fiber and ash content of biscuits were determined by AOAC methods. The carbohydrates were calculated by difference. The sum of moisture, fat, protein, fiber and ash contents was subtracted from 100 to obtain the total carbohydrates by difference (Pearson, 1976). Energy was calculated as described by Sukkar (1985).

2.5 Evaluation of sensory attributes of biscuits

The 9 point Hedonic scale score-card method was used to determine the sensory characteristics of the biscuits made. The quality factors such as color, flavor, texture, taste and overall acceptability were allotted a maximum score of 9 each.

2.6 Evaluation of peroxide value and microbial quality of biscuits

Peroxide value is an indicator of rancidity development during storage. Peroxide value determined by AOAC (2000) procedure.

$$\text{Peroxide value} = \frac{\text{Titre X N X 100}}{\text{Weight of the sample}}$$

Where,

Titre = ml of Sodium Thiosulphate used (blank corrected)

N = Normality of sodium thiosulphate solution.

The total number of microbial count was calculated using the formula given below (Thambekar*et al*., 2009).

No. of microorganisms

(Per g/ml) = No. of colonies × Dilution factor

Weight / volume of aliquots taken (g/ml)

III. RESULT AND DISCUSSION

The experimental findings of utilizing whole egg, finger millet flour and soybean flour for developing high protein and low gluten biscuits are presented and discussed in this chapter. The effect of replacement of refined flour with finger millet flour and a mixture of finger millet flour, soybean flour and whole egg on physicochemical characteristics of biscuits were studied.

3.1 Physical characteristics of biscuits

The result of the physical quality characteristics of the biscuits prepared with whole egg, finger millet flour and soybean flour was given in Table1.

3.2 Sensory quality characteristics of biscuits

The mean score of sensory evaluation for the biscuits are given in Table 2. The T2 (6.40), T5 (7.62) and T9 (6.82) had highest scores for all the sensory attributes compare to other treatments.

Table1. Physical characteristics of biscuits

Treatments	Weight of Biscuit (gm)	Diameter (cm)	Thickness (T) cm	Spread ratio D/T	% Spread factor
C	10.23±0.03	4.88±0.02	0.81±0.02	6.02	100
T1	10.30±0.01	4.82±0.04	0.80±0.01	6.03	100.08
T2	10.25±0.01	4.91±0.01	0.78±0.01	6.29	104.57
T3	10.52±0.01	4.84±0.02	0.78±0.01	6.20	103.08
T4	10.78±0.01	4.91±0.01	0.76±0.01	6.46	107.32
T5	10.21±0.01	4.98±0.01	0.75±0.01	6.64	110.29
T6	10.06±0.02	5.07±0.02	0.72±0.01	7.04	116.97
T7	10.20±0.02	5.35±0.02	0.72±0.01	7.43	123.43
T8	10.50±0.02	5.52±0.01	0.70±0.02	7.88	130.99
T9	10.52±0.02	5.53±0.01	0.70±0.01	7.90	131.23
T10	10.49±0.01	5.52±0.01	0.70±0.01	7.88	130.99
CD value	0.041	0.046	0.037	0.00	0.00

3.3 Shelf life studies of biscuits

The best accepted products from sensory evaluation *i.e.* biscuits mad from T5 (40% finger millet flour, 40% soybean flour and 20% refined wheat flour) and T9 (20% refined wheat flour, 40% finger millet flour, 40% soybean flour and 40% whole egg) treatments were stored in polythene covers for shelf life studies. The samples were observed daily for visual difference and were subjected to sensory evaluation, nutritional characteristics, peroxide value and microbial quality on 0th, 30th, 60th and 90th day.

3.3.1 Mean sensory scores of biscuits during storage period

The results of the mean sensory evaluation of biscuits from initial day to end of storage period are presented in the Table 3. The sensory parameters in T9 sample were decreased from 0th to 90th day for color (7.63 to 7.25), texture (7.80 to 6.23) and overall acceptability (6.82 to 6.10) respectively.

Table2. Mean sensory scores of biscuits

Treatments	Taste	Color	Texture	Flavor	Overall acceptability
C	7.71±0.03	8.10±0.14	8.0±0.14	7.47±0.01	7.82±0.04
T1	7.6±0.55	7.2±0.45	7.4±0.55	7.6±0.55	7.8±0.45
T2	6.0±0.71	5.8±1.1	7.0±0.0	6.2±0.45	6.4±0.55
T3	5.6±0.89	5.6±0.55	6.2±0.84	6.0±0.71	5.8±0.84
T4	7.8±1.09	7.6±0.55	7.6±.55	7.2±0.45	7.4±0.55

T5	8.02±0.04	7.47±0.13	7.40±0.02	7.39±0.01	7.62±0.04
T6	6.4±0.55	7.2±0.84	6.8±0.84	6.6±0.55	6.6±1.14
T7	7.6±0.89	7.6±0.55	7.6±0.55	7.0±0.71	7.4±0.55
T8	7.0±0.71	7.6±0.55	7.6±0.55	6.2±0.45	7.2±0.45
T9	6.80±0.02	7.63±0.12	7.8±0.03	5.80±0.02	6.82±0.06
T10	5.8±0.84	7.8±0.45	7.4±0.55	5.2±0.45	5.6±0.55
CD value	1.024	0.909	0.851	0.739	0.842

Table3. Mean sensory scores of biscuits during storage

Treatments	(Days)	Sensory attributes				
		Color	Texture	Taste	Flavor	Overall
C	0th day	8.1±0.14	8.0±0.14	7.71±0.03	7.47±0.01	7.82±0.04
	30th day	7.85±0.07	7.54±0.06	7.37±0.02	7.42±0.03	7.59±0.01
	60th day	7.62±0.04	7.03±0.03	7.12±0.02	7.26±0.03	7.11±0.01
	90th day	7.24±0.03	6.84±0.05	6.97±0.04	7.07±0.03	6.82±0.02
T5	0th day	7.47±0.13	7.40±0.02	8.02±0.04	7.39±0.01	7.62±0.04
	30th day	7.34±0.05	7.20±0.03	7.59±0.02	6.93±0.03	7.52±0.01
	60th day	7.23±0.06	6.89±0.02	7.02±0.02	6.83±0.03	7.02±0.02
	90th day	7.08±0.01	6.55±0.05	6.80±0.02	6.75±0.06	6.93±0.01
T9	0th day	7.63±0.12	7.8±0.03	6.80±0.02	5.80±0.02	6.82±0.06
	30th day	7.58±0.047	7.01±0.03	6.71±0.01	5.65±0.06	6.52±0.02
	60th day	7.44±0.05	6.84±0.05	6.36±0.03	5.51±0.08	6.40±0.02
	90th day	7.25±0.02	6.23±0.03	6.09±0.01	5.24±0.06	6.10±0.01
CD value	0th day	0.413	0.268	0.109	0.049	0.161
	30th day	0.177	0.133	0.061	0.127	0.049
	60th day	0.167	0.112	0.076	0.169	0.061
	90th day	0.069	0.144	0.077	0.156	0.053

Table4: Nutritional characteristics of biscuits during storage per 100g

Nutrients	Duration	C	T5	T9	CD
Moisture (%)	0th day	2.52±0.08	3.95±0.04	5.32±0.01	0.175
	30th day	3.28±0.21	4.38±0.22	5.91±0.15	0.628
	60th day	4.07±0.21	5.23±0.09	6.60±0.12	0.473
	90th day	5.07±0.12	5.80±0.25	7.12±0.059	0.523
Protein (%)	0th day	7.89±0.05	12.14±0.14	15.66±0.05	0.286
	30th day	7.34±0.13	11.96±0.08	15.57±0.01	0.276
	60th day	7.18±0.03	11.82±0.14	15.37±0.06	0.294
	90th day	6.94±0.07	11.79±0.14	15.26±0.08	0.329
Fat (%)	0th day	15.41±0.01	18.38±0.04	21.16±0.22	0.411
	30th day	15.12±0.14	18.33±0.11	21.07±0.22	0.519
	60th day	15.0±0.11	18.24±0.11	21.04±0.22	0.496
	90th day	14.78±0.09	17.91±0.02	20.94±0.21	0.426
Ash (%)	0th day	0.32±0.01	0.92±0.01	1.13±0.01	0.015
	30th day	0.31±0.01	0.92±0.01	1.11±0.01	0.023
	60th day	0.302±0.01	0.90±0.01	1.02±0.01	0.018
	90th day	0.29±0.01	0.89±0.01	0.98±0.01	0.022
Crude fibre (%)	0th day	0.15±0.01	0.82±0.01	0.83±0.01	0.014
	30th day	0.15±0.01	0.81±0.00	0.80±0.01	0.005
	60th day	0.14±0.01	0.80±0.01	0.75±0.05	0.091

	90th day	0.13±0.00	0.80±0.01	0.68±0.01	0.019
Carbohydrate (%)	0th day	73.44±0.22	63.77±0.23	55.89±0.28	0.782
	30th day	73.81±0.19	63.59±0.03	55.53±0.08	0.401
	60th day	73.29±0.13	63.00±0.182	55.31±0.12	0.466
	90th day	72.78±0.10	62.79±0.09	54.99±0.25	0.529
Energy (k cal)	0th day	465.10±0.28	469.15±0.05	476.72±1.04	1.982
	30th day	460.68±1.57	467.16±1.46	474.09±1.64	4.962
	60th day	456.95±1.40	463.44±0.88	472.08±1.72	4.387
	90th day	451.90±0.93	459.55±1.11	469.53±1.26	3.517

3.3.2 Nutritional characteristics of biscuits during storage

The results of analysis of chemical and nutritional quality characteristics of biscuits during storage are showed in Table 4.

3.4 Peroxide Value and Microbial Quality of Biscuits during Storage

In respect of peroxide value is shown in Table 5. There was no rancidity development observed in the formulated biscuits up to 90 days. Results of microbial quality of biscuits are shown in Table 6.

Table5. Peroxide value of biscuits during storage

Shelf life studies of biscuits	Days	C	T5	T9	CD value
Peroxide values (meq/kg)	0th day	5.53±0.14	5.92±0.09	5.90±0.12	0.386
	30th day	5.68±0.15	6.00±0.01	6.13±0.11	0.336
	60th day	5.92±0.08	6.11±0.11	6.34±0.06	0.263
	90th day	6.05±0.06	6.42±0.11	6.55±0.08	0.276

Table6. Microbial load in biscuits during storage

Days	Total bacterial count ($\times 10^3$CFU)			Total fungal count ($\times 10^3$CFU)		
	C	T5	T9	C	T5	T9
0	Nil	Nil	Nil	Nil	Nil	Nil
30	Nil	1.0	1.0	Nil	1.0	1.0
60	1.0	2.0	3.0	1.0	1.0	2.0
90	2.0	2.0	4.0	2.0	2.0	3.0

IV. CONCLUSIONS

It was concluded that the whole egg, finger millet and soybean flour can be successfully incorporated in bakery products as it enhances the nutritional quality, functional properties and shelf life of the biscuits. Nutritional evaluation of best rated high protein and low gluten biscuits (refined wheat flour- 10%, finger millet flour- 20%, soya bean flour- 20%, whole egg-20%, sugar- 15% and fat- 15%) were protein (15.66 ± 0.05%), fat (21.16 ± 0.22%), ash (1.13 ± 0.01%), moisture (5.32 ± 0.001%) and 476.72 kcal of energy. The mineral content of high protein and low gluten biscuits was calcium (79.13±0.15), phosphorus (177.72±0.04) and iron content was (2.69±0.14). The bacterial count and fungi count of the high protein and low gluten biscuits sample after 90 days was 4x10³CFU/g and 3x10³CFU/g this was well below the acceptable limit and there was no rancidity development observed in the formulated biscuits up to 90 days. Moreover this finished product can be consumed by socio economically poor and vulnerable groups of people because of its low cost for production.

V. ACKNOWLEDGEMENT

I take immense pleasure in thanking V. Bhasker **(**Assistant Professor), Food Technology, University College of Technology, for his guidance and cooperation extended to me to enable the completion of this work. I also thank Ramu Golla (lab chemist), Telangana Foods, I.D.A., Nacharam, Hyderabad, for his continuous guidance and encouragement during the course of project.

VI. BIBLIOGRAPHY

[1]. Sharma, H.K.; Tewari, S.; Singh, M. and Goyal, P. 1998. Bakery products in next

millennium. *Beverage and Food World* 12: 40-46.

[2]. Nagarkoti, M. 2005.Incorporation of finger millet flour in biscuits. M.Sc. Thesis (Foods technology).G.B Pant University of Agriculture and Technology, Pantnagar.

[3]. Akubor PI and Ukwuru MU 2005 Functional properties and biscuit making potential of soybean and cassava flour blends. Plant Foods for Human Nutrition, 58 (3): 1-12.

[4]. Berk, Z. (1992). Technology of production of edible flours and protein products from soybeans. FAO Agricultural Services Bulletin No. 97. Food Agriculture Organization of the United Nations, Rome.

[5]. Lusas, E. W. and Riaz, M. N. (1995). Soy protein products: processing and use. *Journal of Nutrition*, 125(Suppl.3):573S-580S.

[6]. Pyler, E. J. (1994). Baker's handbook. Sosland Publishing, Kansas City, MO.

[7]. Wolf, W. J. (1975). Lipoxygenase and flavour of soybean protein products. *Agricultural and Food Chemistry* 23(2):136-141.

[8]. Kanzamar, G. J., Predin, S. J., Oreg, D. A. and Csehak, Z. M. (1993). Processing of soy flours/grits and texturized soy flours. In: Proceedings of the World Conference on Oilseed Technology and Utilization (Apple white, T. H., ed.), pp. 226-240. AOCS Press, Champaign, IL.

[9]. Mustakas, G. C. (1971). Full-fat and Defatted Soy Flour for human nutrition. *Journal of the American Oil Chemists Society* 48(12):815-819.

[10]. Riaz, M. N. (2006). Soy Applications in Foods. London: CRC Taylor and Francis pp. 39-226.

[11]. Dubois, D.K. 1980. Soy Products in Bakery Foods, Technical Bulletin. *Volume II, Issue 9, American Institute of Baking*, Manhattan, KS, USA.

[12]. Hulse, J. H., Laing, E. M., & Pearson, O. E. (1980). Sorghum and the millets: Their composition and nutritive value. London: Academic Press.

[13]. Gopalan, C., Rama Sastri, B. V., & Balasubramanian, S. C. (2009). Nutritive value of Indian foods. Hyderabad, India: National Institute of Nutrition, Indian Council of Medical Research.

[14]. Food and Agricultural Organization of the United Nations. (1995). Sorghum and millets in human nutrition (FAO Food and Nutrition Series, No. 27). ISBN 92-5- 103381-1.

[15]. Malathi, D., & Nirmalakumari, A. (2007). Cooking of small millets in Tamil Nadu. In K. T. Krishne Gowda & A. Seetharam (Eds.), Food uses of small millets and avenues for further processing and value addition (pp. 57–63): Indian Council of Agricultural Research. Project Coordination cell, All India Co-ordinated small millets improvement project. Indian Council of Agricultural Research, UAS, GKVK, Bangalore, India.

[16]. Achaya, K. T. (2009). The illustrated food of India A–Z. New Delhi, India: Oxford University Press.

[17]. Singh, P. (2008). History of millet cultivation in India. In L. Gopal & V. C. Srivastava (Eds.), History of science, philosophy and culture in Indian civilization, Volume V, Part I, History of Agriculture in India (up to c.1200 AD) (pp. 107–119). New Delhi: PHISPC, Centre for Studies in Civilizations. Concept Publishing Company.

[18]. AACC. 2000. Approved Methods of the *American Association of Cereal Chemists*. 10thEdition.St Paul Minnesota, MN. USA.

[19]. A.A.C.C. (1983) Approved Method of Analysis of *American Cereals Chemists, General Laboratory method*, St. Paul, Minnesota, U.S.A.

[20]. Agrawal S.R. (1990) Prospects for small-scale biscuits industry in the nineties. *India Food Industry*, 19-21.

[21]. Baisya, R.K. (2007) Bakery Industry in India. *Processed Food Industry*, 10:13.

[22]. Kaur, A.P., Shukla, F.C. and Kaur, A. (2004) Present scenario & future needs of bakery industry in India. *Proc Food Industry*, pp: 13-15.

[23]. Patel, I.N., Rema, S. and Kamaliya, K.B. (2003) Biscuits ingredients. *Proc Food Ind*, 44-49.

[24]. Ahmad, S and Ahmed, M. 2014. A review on biscuit, a largest consumed processed product in India, its fortification and nutritional improvement. *International Journal of Science Inventions Today.*3 (2): 169-186.

[25]. AOAC. 1981. Official Methods of Analysis for fat and carbohydrate. *Association of Official Analytical Chemists*.13th Edition. Washington, DC.

[26]. AOAC. 1984. Official Methods of Analysis for ash. *Association of Official Analytical Chemists*.14th Edition. Washington, DC.

