International Journal of Farm Sciences **6(4)** : 6-13, 2016

Development and evaluation of soybean and finger millet incorporated Sukhdi: an Indian snack

JASPREET KAUR, VH KANBI and MK CHAUDHARY

Department of Food Science and Nutrition
ASPEE College of Home Science and Nutrition
Sardarkrushinagar Dantiwada Agricultural University
Sardarkrushinagar 385506 Gujarat, India
Email for correspondence: jaspreetmaan9319@gmail.com

ABSTRACT

The traditional Sukhdi is rich source of energy but lacks in balanced nutrients. To improve its nutritional value for balanced diet and also to make it helpful for prevention of protein energy malnutrition along with wheat flour, ragi and soybean flour were added in different proportions of wheat, ragi and soybean flour. The quantity of Ashwagandha root powder (4 g), jaggery (70 g) and ghee (60 g) were kept common in all the treatments for preparation of Sukhdi. The fat, protein, lysine, methionine, ash, calcium, iron and crude fiber content in Sukhdi increased significantly with increase in proportion of ragi and soybean flour as compared to the control. The moisture content in different treatments of Sukhdi ranged from 4.96 to 6.09, fat 26.22 to 29.36, carbohydrate 46.24 to 59.67 and protein 10.11 to 20.02 per cent; lysine 1.33 to 3.50 and methionine 1.16 to 2.07 g/16 g N; ash 1.30 to 2.22 per cent; iron 5.06 to 11.28 mg/100 g; crude fiber 1.01 to 1.94 per cent and the energy value 513.90 to 529.34 Kcal /100 g. The results of sensory evaluation revealed that the appearance and colour scores of Sukhdi were slightly increased while flavour, mouth feel, texture and overall acceptability scores of decreased with increase in proportion of ragi and soybean flour. The results of storage quality revealed that this Sukhdi could be stored and safely used up to 10 to 15 days without affecting its quality.

Keyword: Wheat; ragi; soybean; flour; nutritional composition; Sukhdi

INTRODUCTION

Malnutrition is a major problem in India especially in rural populations. To combat malnutrition development of protein, calcium and iron-rich supplementary food based on cheap and locally available foodstuffs which are familiar among all groups of the society has been one of the strategies. For a large population which cannot afford prohibitive prices, the choice of feeding is quite limited. Sukhdi is a Gujarati sweet made from wheat flour and jaggery in ghee. Wheat (*Triticum aestivum* L) has been described as 'Stuff of life' and is one of the most important

staple food crops. Wheat (whole grain) contains 12.8 g moisture, 11.8 g protein, 1.5 g fat, 1.2 g crude fiber, 71.2 g carbohydrates, 41 mg calcium and 5.3 mg iron per 100 g (Gopalan et al 2004). Finger millet (*Eleusine coracana* G) also known as ragi in India is an important staple food in the eastern and central Africa as well as in some parts of India (Majumder et al 2006). The panicle consists of a group of digitally arranged spikes often referred to as fingers. It contains 13.1 g moisture, 7.3 g protein, 1.3 g fat, 3.6 g crude fiber, 72.0 g carbohydrates, 344 mg calcium and 3.9 mg iron per 100 g (Gopalan et al 2004). Ragi is traditionally fed to women after child birth. It is also used for a flavoured drink in festivals. Its major use is in the traditional preparations (Amadou et al 2011).

Soybean (*Glycine max* L) is known as the 'Miracle bean' of the 20th century. It is a versatile crop with innumerable possibilities of improving agriculture and supporting industry. Soybean plays vital role in balancing the protein deficiency in human diet (Akubor and Ukwuru 2003). Protein content of soy is about two times of other pulses, four times of wheat, six times of rice grain and four times of milk. Ashwagandha (*Withania somnifera* L) is also known as Indian ginseng or winter cherry and is one of the important ingredients in Ayurveda and other traditional systems of medicine. Ashwagandha can be used as a tonic or in oral form. It is a natural stress-reliever and also improves body strength and stamina.

MATERIAL and METHODS

A standardized procedure was followed for preparation of Sukhdi. Moisture, fat and ash contents were determined by the official method as given by Anon (1984), carbohydrate content by the Anthrone method as described by Sadasivam and Manickam (1992), protein content by Lowry's method given by Lowry et al (1951), lysine by the nitropyridine method as described by Tsai et al (1972), methionine by the nitroprusside method as described by Horn et al (1947), crude fiber as per the method given by Raghuramula et al (1983), calcium by titrimetric method as described by Raghuramulu et al (2003) and iron by the method of Ramsey (1953). Energy value was calculated from fat, protein and carbohydrate found in Sukhdi. The sensory quality was assessed by composite scoring test suggested by Ranganna (1999). Total cost was calculated according to market rate of per kg raw ingredient.

To improve the nutritional value for balanced diet of Sukhdi and also to make it helpful for prevention of protein energy malnutrition along with wheat flour, ragi and soybean flour were added in different proportions of wheat, ragi and soybean flour viz T_1 (100:0:0, control), T_2

(80:10:10), T_3 (60:20:20), T_4 (70:20:10), T_5 (70:10:20), T_6 (60:10:30), T_7 (60:30:10), T_8 (40:30:30), T_9 (80:20:0) and T_{10} (80:0:20). The quantity of Ashwagandha root powder (4 g), jaggery (70 g) and ghee (60 g) were kept common in all the treatments for preparation of Sukhdi.

RESULTS and DISCUSSION

Data on various constituents of Sukhdi made using different treatments are given in Table 1.

The moisture content in different treatments ranged from 4.96 to 6.09 per cent. There was no difference among various treatments wrt moisture content the differences being non-significant. Apotiola and Fashakin (2013) reported similar results for cookies made from blends of cocoyam, soybean and wheat flour. The fat content ranged from 26.22 to 29.36 per cent with T_6 having the highest (29.36%) which was at par with T_8 (28.66%) and T_5 (27.85%) as compared to 26.22 per cent in T_9. Soybean is an oilseed crop and incorporation of its flour might have inevitably increased the fat content in Sukhdi. Chappalwar et al (2013) studied the composition of cookies made up of oats and finger millet-based composite flour and found the crude fat content between 21.32 to 23.37 per cent.

The carbohydrate content of different treatments ranged from 46.24 to 59.67 per cent with highest in T_9 (59.67%) which was at par with T_1 (59.01%) and lowest in T_6 (46.24%). Sanful and Darko (2010) reported that fortification of bread and biscuit with either the defatted soy flour or the chickpea flour at different levels led to decrease in carbohydrates but caused a slight increase in protein, ash and fibre contents.

The protein content ranged from 10.11 to 20.02 per cent with highest in T_6 (20.02%) which was at par with T_8 (19.36%) and lowest in T_9 (10.11%) and control T_1 (10.30%). Ragi contains less protein as compared to wheat therefore treatment T_9 contained less protein then the control. The increase in protein content could be due to the increase in the proportion of soybean in the flour blend. Soybean is a rich source of protein and incorporation of its flour inevitable increased the protein content in the Sukhdi. Mishra and Chandra (2012) also studied the supplementation of wheat flour with soya and rice bran at 10, 15, 20 and 25 per cent levels for preparation of biscuits and reported that supplementation of soy flour and rice bran at 15 per cent level each improved the nutritional quality without adversely affecting the sensory parameters.

The lysine content of different treatments ranged from 1.33 to 3.50 g/16 g N. The data show that as the percentage of ragi and soybean flour increased in the treatments the lysine content also increased.

Table 1. Effect of different treatments on various nutrients of Sukhdi

Treatment (WF:RF:SF)	Moisture (%)	Fat (%)	CHO (%)	Protein (%)	Lysine (g/16 g N)	Methionine (g/16 g N)
T_1 (100:0:00)	4.96	26.30	59.01	10.30	1.33	1.63
T_2 (80:10:10)	5.38	27.15	52.89	15.19	2.39	1.66
T_3 (60:20:20)	6.09	27.47	52.01	15.68	2.93	1.71
T_4 (70:20:10)	5.87	27.26	53.86	14.87	2.41	1.78
T_5 (70:10:20)	5.16	27.85	46.93	18.39	2.56	1.44
T_6 (60:10:30)	5.19	29.36	46.24	20.02	3.28	1.41
T_7 (60:30:10)	5.68	27.11	53.87	14.19	2.60	2.07
T_8 (40:30:30)	5.40	28.66	47.75	19.36	3.50	1.72
T_9 (80:20:00)	5.42	26.22	59.67	10.11	2.17	2.02
T_{10} (80:0:20)	5.15	27.50	51.77	15.97	2.34	1.16
Mean	5.43	27.49	52.40	15.41	2.55	1.66
SEm±	0.317	0.538	0.694	0.422	0.227	0.024
CD	NS	1.597	2.062	1.266	0.681	0.072
CV (%)	10.11	03.42	04.28	03.35	06.91	02.52

T_1= Control, WF= Wheat flour, RF= Ragi flour, SF= Soybean flour

Table 1. Contd...

Treatment (WF:RF:SF)	Ash (%)	Calcium (mg/100 g)	Iron (mg/100 g)	Crude fiber (%)	Energy value (Kcal/100 g)
T_1 (100:0:00)	1.30	080.16	05.06	1.01	513.90
T_2 (80:10:10	1.51	106.88	08.55	1.21	523.62
T_3 (60:20:20)	1.80	180.36	09.53	1.49	523.90
T_4 (70:20:10)	1.66	152.53	06.61	1.51	520.30
T_5 (70:10:20)	1.73	139.17	10.50	1.28	514.97
T_6 (60:10:30)	2.04	163.66	11.05	1.56	529.34
T_7 (60:30:10)	1.73	188.15	05.08	1.23	515.10
T_8 (40:30:30)	2.22	219.33	11.28	1.94	525.06
T_9 (80:20:00)	1.42	122.47	05.77	1.02	515.14
T_{10} (80:0:20)	1.75	107.99	10.22	1.03	518.45
Mean	1.72	146.06	08.37	1.32	519.97
SEm±	0.064	09.408	0.609	0.069	07.652
CD	0.134	19.624	1.808	0.207	NS
CV (%)	04.60	07.98	06.59	09.00	02.50

T_1= Control, WF= Wheat flour, RF= Ragi flour, SF= Soybean flour

The methionine content of different treatments ranged from 1.16 to 2.07 g/16 g N. Hefnawy et al (2012) reported that 85 per cent wheat + 15 per cent chickpea flour and 70 per cent wheat + 30 per cent chickpea flour contained 1.32 to 1.53 g methionine/16 g N and lysine content of 3.12 and 5.24 g/16 g N respectively. Their results also indicated that adding of chickpea flour in second treatment increased total protein from 8.3 to 17.2 per cent.

The ash content of treatments ranged from 1.30 to 2.22 per cent. Aleem et al (2012) reported that incorporation of 20 per cent of soybean led to 1.75 per cent ash content. The calcium content ranged from 80.16 to 219.33 mg/100 g. Data show that as the percentage of ragi and soybean flour increased in the treatments the calcium content also increased. The iron content ranged from 5.06 to 11.28 mg/100 g. Rani et al (2008) also recorded similar results for biscuits prepared by using 100 per cent whole wheat flour (WWF) and WWF with 15 per cent soybean flour contained 6.06 to 6.80 mg/100 g iron content. The crude fiber content ranged from 1.01 to 1.94 per cent and the energy value of treatments ranged from 513.90 to 529.34 Kcal/100 g.

Data on organoleptic evaluation of Sukhdi are given in Table 2. The appearance score of different treatments ranged from 16.00 to 17.70 out of 20, the colour score from 11.68 to 13.70 out of 15. However there was no significant difference among all treatments for appearance and colour. Aleem et al (2012) reported that colour characteristics of biscuits were found to be darker with increase in concentration of defatted soy flour which enhanced consumer appeal up to 20 per cent.

The flavour score of treatments ranged from 17.00 to 21.60 out of 25 with no significant differences among the treatments. Onweluzo and lwezu (1998) reported decreasing trend in the flavour score of the biscuits enriched with soy flour.

The mouth feel score of treatments ranged from 15.20 to 17.10 out of 20. The analysis of variance for mouth feel score of nutritious Sukhdi showed no significant differences among treatments as prepared by using different proportions of ragi and soybean flour. Ugwuona (2009) reported that the colour, flavour, mouth feel and overall acceptability of biscuits were not significantly affected by the 5, 10, 15 and 20 per cent soy flour replacement for wheat flour.

The overall acceptability score of treatments ranged from 77.90 to 85.80 out of 100. Though statistically there were no significant differences among the treatments the overall acceptability score of Sukhdi was gradually reduced with increasing proportion of ragi flour, soybean flour and Ashwagandha root

Table 2. Organoleptic evaluation of different treatments of (fresh) Sukhdi

Treatment (WF:RF:SF)	Appearance (20)	Colour (15)	Flavour (25)	Mouthfeel (20)	Texture (20)	Overall acceptance (100)
T_1 (100:0:00)	16.80	13.00	21.60	17.10	17.40	85.90
T_2 (80:10:10)	16.70	12.70	20.50	15.40	17.10	82.40
T_3 (60:20:20)	16.50	13.10	21.50	16.00	16.70	83.80
T_4 (70:20:10)	16.30	12.60	20.80	16.70	16.60	83.00
T_5 (70:10:20)	17.40	13.40	19.20	16.30	16.50	82.50
T_6 (60:10:30)	16.50	12.70	19.10	15.20	17.10	80.60
T_7 (60:30:10)	16.00	11.68	20.30	15.80	16.30	80.08
T_8 (40:30:30)	16.40	12.48	20.40	15.50	17.30	82.09
T_9 (80:20:00)	16.60	12.80	21.35	16.30	16.80	83.85
T_{10} (80:0:20)	17.70	13.70	19.30	15.30	16.40	82.40
Mean	16.74	12.82	20.50	15.96	16.89	82.88
SEm±	0.596	0.457	0.541	0.641	0.375	1.451
CD	NS	NS	NS	NS	NS	NS
CV (%)	11.91	11.48	08.57	12.35	06.96	05.57

T_1= Control, WF= Wheat flour, RF= Ragi flour, SF= Soybean flour

powder. Thus incorporation of up to 30 per cent ragi and soybean flour were acceptable for some characters and stood at par while some characters were slightly reduced. Khan et al (2005) recorded observations on chapattis prepared by soy flour supplementation and soy flour addition up to 24 per cent was acceptable by the panel of judges.

Storage quality evaluation

To study the storage quality of the product the samples of Sukhdi were packed in steel container and kept at room temperature for maximum duration. The observations on organoleptical evaluation viz appearance, colour, flavour, mouth feel, texture, overall acceptability and any microbial contamination were recorded at 5 days interval up to 30 days. It was found that Sukhdi could be stored and used up to 10 days without any change and up to 15 days with a very slight change in organoleptic attributes.

Cost of Sukhdi

Total cost of Sukhdi indicated that there was slight variation recorded among all the treatments. Treatment T_1 (100:00:00) was the cheapest among all the treatments but looking at the presence of important nutrients T_8 (40:30:30), T_6 (60:10:30) and T_3 (60:20:20) were found economical to overcome the problem of malnutrition.

CONCLUSION

The incorporation of ragi and soybean flour along with wheat flour in

Sukhdi enriched its nutritive qualities. To prepare Sukhdi with high nutritional qualities wheat flour could be replaced with up to 60 per cent ragi and soybean flour each at 30 per cent. Thus ragi and soybean flour incorporated Sukhdi will help in increasing intake of protein, lysine, methionine, crude fiber, calcium and iron and help in prevention of protein energy malnutrition (PEM) and anemia widely prevalent amongst children.

REFERENCES

Akubor PI and Ukwuru MU 2003. Functional properties and biscuit making potential of soybean and cassava flour blends. Plant Foods and Human Nutrition **58(3):** 1-12.

Aleem Zaker MD Genitha TR and Hashmi SI 2012. Effects of defatted soy flour incorporation on physical, sensorial and nutritional properties of biscuits. Journal of Food Processing and Technology **3(4):** 149. doi: 10.4172/2157-7110.1000149.

Amadou I, Gbadamosi OS and Guo-Wei L 2011. Millet-based traditional processed foods and beverages- a review. Cereal Food World **56(3):** 115-121.

Anonymous 1984. Official methods of analysis. 10th edn, Association of Official Analytical Chemists, Washington, DC.

Apotiola ZO and Fashakin JF 2013. Evaluation of cookies from wheat flour, soybean flour and cocoyam flour blends. Food Science and Quality Management **14:** 17-21.

Chappalwar VM, Peter D, Bobde H and John SM 2013. Quality characteristics of cookies prepared from oats and finger millet-based composite flour. International journal of Engineering Science and Technology **3(4):** 677-683.

Gopalan C, Ramasastri BV and Balasubramanian, SC 2004. Nutritive value of Indian foods. National Institute of Nutrition, Indian Council of Medical Research. Hyderabad, AP, India, 156p.

Hefnawy TMH, El-Shourbagy GA and Ramadan, MF 2012. Impact of adding chickpea (*Cicer arietinum* L) flour to wheat flour on the rheological properties of toast bread. International Food Research Journal **19(2):** 521-525.

Horn MJ, Jones DB and Blum AE 1947. Microbiological determination of valine in proteins and foods. Journal of Biological Chemistry **170:** 719-723.

Khan MI, Anjum FM, Hussain S and Tariq MT 2005. Effect of soy flour supplementation on mineral and phytate contents of unleavened flat bread (chapatis). Journal of Nutrition and Food Science **35(3):** 163-168.

Lowry OH, Rosebrough NJ, Farr AL and Randall RJ 1951. Protein measurement with the folin phenol reagent. Journal of Biological Chemistry **193(1):** 265-275.

Majumder TK, Premavalli KS and Bawa AS 2006. Effect of puffing on calcium and iron contents of ragi varieties and their utilization. Journal of Food Science and Technology **42(5):** 542-545.

Mishra N and Chandra R 2012. Development of functional biscuit from soy flour and rice bran. International Journal of Agricultural and Food Science **2(1):** 14-20.

Onweluzo JC and lwezu EN 1998. Composition and characteristics of cassava-soybean and wheat-soybean biscuits. Journal of Food Science and Technology **35(2):** 128-131.

Raghuramula N, Madhavan K and Kalyanasundaram S 2003. A manual of laboratory techniques. National Institute of Nutrition, Indian Council of Medical Research. Hyderabad, AP, India.

Raghuramula N, Nair MK and Kalyanasundaram S 1983. A manual of laboratory techniques. National Institute of Nutrition, Indian Council of Medical Research. Hyderabad, AP, India.

Ramsey WNM 1953. The determination of iron in blood plasma or serum. Biochemical Journal **53:** 227-231.

Ranganna 1999. Manual of analysis of fruits and vegetables products. Tata McGrew-Hill Publishers Co Ltd, New Delhi, India, pp 634p.

Rani V, Grewal RB and Khetarpaul N 2008. Sensory and nutritional evaluation of soy supplemented nutritious baked products. Journal of Dairying, Foods and Home Sciences **27(3-4):** 209-215.

Sadasivam S and Manickam A 1992. Biochemical methods for agricultural sciences. Wiley Eastern Limited, New Delhi, India, pp 11-12.

Sanful RE and Darko S 2010. Utilization of soybean flour in the production of bread. Pakistan Journal of Nutrition **9(8):** 815-818.

Tsai OY, Hansel LW and Nelson OE 1972. A colorimetric method of screening maize seeds for lysine content. Cereal Chemistry **49(5):** 572-579.

Ugwuona FU 2009. Chemical and sensory evaluation of soy-fortified cassava wheat biscuit. Journal of Tropical Agriculture, Food, Environment and Extension **8(1):** 55-59.

Received: 14.11.2015 ***Accepted: 12.2.2016***