

752

Table 7. Mean width, thickness and spread factor of cookies containing different levels of wheat germ (WG) and sunflower kernels (SEK).

Level of WG/SEK	Width (cm)		Thickness (cm)		Spread factor	
	WG	SEK	WG	SEK	WG	SEK
0	7.68	7.62	1.22	1.22	6.14	6.14
2	7.70	7.41	1.26	1.30	5.70	5.70
10	7.72	7.42	1.29	1.33	5.28	5.28
15	7.80	7.43	1.70	1.33	5.60	5.60
20	7.77	7.22	1.31	1.32	5.48	5.48
25	7.72	7.02	1.31	1.33	5.28	5.28
30	7.82	6.92	1.31	1.30	5.11	5.11
F value (P = 0.05)	27.26	120.92	1.81 N.S.	2.92 N.S.	380.08	3907.94
LSD at 5% significance	0.142	0.14			0.02	0.02

N.S. = Non-significant.

kernels in the formulation. Cragg and Paine (1989) also reported reduced spread factor with increased levels of sunflower protein isolate in the cookie formulation.

Conclusion

From the foregoing discussion it can be concluded that excellent cookies can be made using wheat germ and sunflower kernels as partial replacement. This makes cookies an attractive snack for the diet of feeding programme. Obesity and other metabolic diseases of the population, but these cookies have a tendency to become rancid, unless properly packaged and stored. With the recent developments in packaging that the shelf-life of cookies can easily be extended to desirable time periods. It is recommended that nutritious cookies can be prepared by replacing wheat flour with sunflower kernels when given a level of 20 percent without adversely affecting the overall acceptability of the product.

**THE BRITISH LIBRARY**



**Document Supply Centre**

This document has been supplied by or on behalf of  
 The British Library Document Supply Centre  
 Boston Spa, West Yorkshire LS23 7BQ  
 UNITED KINGDOM

**WARNING:** Further copying of this document (including storage in any medium by electronic means), other than that allowed under the copyright law, is not permitted without the permission of the copyright owner or an authorised licensing body.

- Newman RK, Newman CW (1987)  $\beta$ -glucanase effect on the performance of broiler chicks fed covered and hull-less barley isotypes having normal and waxy starch. *Nutr Rep Int* 36: 693-699
- Proskey LH, Asp G, Schweizer TF, DeVries JW, Furda I (1988) Determination of insoluble, soluble, and total dietary fiber in foods and food products: Interlaboratory study. *J Assoc Off Anal Chem* 71: 1017-1023
- Qureshi AA, Burger WC, Peterson DM, Elson CE (1986) The structure of an inhibitor of cholesterol biosynthesis isolated from barley. *J Biol Sci* 261: 10544-10550
- SAS (1985) *Statistical Analysis System Users Guide: Statistics SAS Institute Cary NC*
- Snedecor GW, Cochran WG (1980) *Statistical Methods, 6th edn Iowa State University Press, Ames IA* pp. 172-198
- Ullrich SE, Clancy JA, Eslick RF, Lance RCM (1986)  $\beta$ -glucan content and viscosity extracts from waxy barley. *J Cereal Sci* 4: 279-285
- Weber FE, Chaudhury V, Chicoye E, Qureshi AA (1989) Cholesterol regulation by cereals and the solvent extracts of the spent grain's product. *Amer Soc Cell Biol and Amer Soc Biochem and Molec Biol meetings San Francisco CA* (Abstr)
- Van Horn LV, Liu K, Parker D, Emidy L, Liao Y, Pan WH, Giumetti D, Hewitt J, Stamler J (1986) Serum lipid response to oat product intake with a fat modified diet. *J Am Diet Assoc* 86: 759-764

## Studies on the development of nutritious cookies utilizing sunflower kernels and wheat germ

MUKTI BAJAJ, AMARJIT KAUR & J.S. SIDHU\*

*Dept. of Food Science and Technology, Ludhiana, 141004 (Pb), India*

(\* author for correspondence)

Received 22 October 1990; accepted in revised form 22 February 1991

**Abstract.** Wheat germ and sunflower kernels were substituted at a level of 0, 5, 10, 15, 20, 25 and 30 percent of wheat flour for the preparation of cookies. The crude protein, ash and crude fiber contents increased with the addition of sunflower kernels. Similarly, with the addition of wheat germ, protein, ash and crude fibre contents increased significantly. The cookies containing 30% wheat germ and 20 percent sunflower kernels were found to be superior in overall acceptability.

### Introduction

In the health conscious world of today, nutrition helps in selling new food products prepared from novel protein sources. Sunflower is one such potential protein supplement for the human diet, mainly due to its superior nutritional quality and absence of any antinutritional factors (Wan *et al.* (1979); Burns *et al.* (1972)). Although it is mostly used for oil, the residual meal finds good market in ruminant feeds. The use of oilseed proteins in feeding humans is becoming necessary because of rapidly increasing populations in this part of the world. Just like sunflower, wheat germ is also a unique source of highly concentrated nutrients. It offers three times as much protein of high biological value, seven times as much fat, fifteen times as much sugar and six times as much minerals when compared with wheat endosperm. In addition to this, wheat germ is reported to be the richest known source of tocopherols (Vitamin E) of plant origin and also rich source of thiamine, riboflavin and niacin. In view of its high nutritive value and palatability, wheat germ offers an excellent source of protein and vitamins for fortification of food products (Shurpalekar and Haridas Rao (1975) and Jedryszek (1987)).

The wide prevalence of protein and calorie malnutrition among the vulnerable segments of the population in many developing countries has been reported by various workers (Scrimshaw & Behar (1959); Bressani & Elias (1968); Narayana Rao & Swaminathan (1970)). Consequently, a

*Table 1.* Proportion of different ingredients in cookie formulation.

Ingredients	Quantity
Wheat flour	90.0 g
Sugar	52.0 g
Shortening	25.6 g
Dextrose soln. (5.93%)	13.2 ml
Sodium bicarbonate	1.0 g
Sodium chloride	0.84 g
Water	6.4 ml

worldwide search has been in progress during the last few decades to discover hitherto unknown or unutilised resources of food nutrients to meet the challenge of hunger.

Cookies, which are important snack foods, are judged for quality, based mainly on top grain, texture and flavour. Taste of high protein cookies must be as good as that of other varieties or they will not be eaten (Lorenz (1978)). Keeping this in view, the present study was carried out to incorporate sunflower kernels and wheat germ in cookies at varying levels to produce an acceptable and nutritious product.

## Materials and methods

### *Materials*

Sunflower seeds were collected from department of Plant Breeding, PAU, Ludhiana. Wheat germ and flour used for cookie preparation were obtained from a local flour mill.

Sunflower seeds were soaked in luke warm water for 15 minutes to loosen the hull. The seeds were then rubbed in the hands to remove the hulls; subsequently dried to a moisture content of 4–6 percent and kept in refrigerator until further use.

### *Preparation of cookies*

The standard AACC method (1983) was adopted to prepare cookies of acceptable color and texture. The basic formulation used for cookie making is shown in Table 1. Wheat germ and sunflower kernels were substituted at the rate of 0, 5, 10, 15, 20 and 30 percent of wheat flour (w/w basis). Cookies were baked in an electric oven at 200 °C for 10–12 minutes. These were allowed to cool for 30 minutes, packaged in polyethylene bags and stored in airtight containers for further studies.

Table 2. Chemical composition of sunflower kernels, wheat germ and wheat flour used in cookie preparation.

Constituent (%)	Sunflower kernels <sup>2</sup>	Wheat germ	Wheat flour
Crude fat	43.77	7.02	0.4
Protein ( $N \times 5.7$ )	21.93	20.48	9.87
Ash	4.36	1.59	0.299
Crude fibre	3.81	3.41	0.19

### Physicochemical analysis

Representative samples of cookies were crushed and analysed for protein ( $N \times 5.7$ ), moisture, ash and crude fiber according to standard AOAC methods (1980) and results were expressed on 14 percent moisture basis.

Cookie width (W) was measured by placing 4 cookies edge to edge. After rotating them through 90°, measured again to get the average width. Cookie thickness (T) was measured by stacking four cookies on top of each other. Spread factor (SF) was determined from the ratio of width and thickness measurements.

Sensory analysis of cookies was carried out by a group of six semi-trained panelists for top grain, texture, flavour, and overall acceptability on a 6-point hedonic scale; where 6 represents excellent, 5 very good, 4 good, 3 fair, 2 poor and 1 unacceptable.

The data were analysed statistically for analysis of variance and means were compared using Duncan's multiple range test (Duncan, 1955).

### Results and discussion

Data on chemical composition of sunflower kernels, wheat germ and flour used in cookie formulations reveal that the sunflower kernels and wheat germ are very nutritious ingredients containing higher amounts of proteins, minerals and dietary fibre (Table 2). In addition, sunflower kernel had very high fat content (43.8%); which has been reported to be rich in unsaturated essential fatty acids like linoleic and linolenic (Earle *et al.*, 1968).

The chemical composition of cookies formulated with different levels of wheat germ is given in Table 3. Protein content of control cookies increased from 6.7 to 12.2 percent with the addition of 30 percent wheat germ, thereby improving the nutritive value significantly. Similarly, there was a proportionate increase in ash and crude fibre contents in wheat germ cookies. Protein, ash and crude fiber contents of cookies also increased because of supplementation with sunflower kernels up to a level of 30 percent (Table 4).

Table 3. Chemical composition of cookies formulated with different levels of wheat germ.

Level of wheat germ (%)	Protein ( $N \times 5.7$ ) (%)	Ash (%)	Crude fiber (%)
0			
5	6.66	0.25	0.36
10	7.52	0.81	0.81
15	8.12	0.95	1.04
20	9.89	1.25	1.31
25	10.55	1.39	1.73
30	11.41	1.53	1.73
F value ( $P = 0.5$ )	12.20	1.81	1.94
Least significant difference	318.78	17223.78	12221.65
	0.82	0.03	0.03

Protein content increased from 6.7 to 13.1, ash from 0.25 to 1.04 and crude fiber content from 0.36 to 1.72 percent as the level of sunflower kernels were increased from 0 to 30 percent. Increase in protein content by replacing 20 percent wheat flour with sunflower protein isolate has also been reported by Cloughton and Pearce (1989). Increase in ash and fiber contents may be attributed to the increased proportions of sunflower kernels in the formulations.

Mean sensory scores for cookies containing different levels of wheat germ and sunflower kernels in the formulations are given in Tables 5 and 6, respectively. The top grain, texture and flavour scores did not differ significantly when the level of wheat germ was increased from 0 to 30 percent in the cookie formulation. It was obtained that cookies containing 30% wheat germ scored higher than control for overall acceptability. The sunflower kernels at a level of 15 and 20 percent were found to be superior in

Table 4. Chemical composition of cookies formulated with different levels of sunflower kernels.

Level of sunflower levels (%)	Protein (%)	Ash (%)	Crude fiber (%)
0			
5	6.66	0.25	0.36
10	7.64	0.49	0.63
15	8.28	0.70	0.81
20	9.92	0.78	1.25
25	11.55	0.98	1.22
30	11.95	0.91	1.43
F value ( $P = 0.05$ )	13.11	1.04	1.72
Least significant difference	3835.88	56446.42	267.73
	0.295	0.008	0.29

Table 5. Mean sensory scores for cookies containing different levels of wheat germ in the formulation.

Level of wheat germ (%)	Top grain	Texture	Flavor	Overall quality
0	5.0	4.0	4.0	4.30
5	5.0	5.0	5.0	5.00
10	5.0	5.0	6.0	5.33
15	6.0	6.0	6.0	6.00
20	6.0	6.0	4.0	5.33
25	4.0	5.0	5.0	4.67
30	4.0	5.0	5.0	4.67
F ratio at 0.05%	1.78 N.S.	1.01 N.S.	1.91 N.S.	655.67
Least significant difference				0.141

N.S. = Non-significant.

overall acceptability. The scores for top grain decreased with increasing proportions of sunflower kernels. Interestingly, the scores for texture and flavour improved with increasing levels of sunflower kernels. Claughton and Pearce (1989) have reported that scores for surface grain of cookies were reduced when the levels of sunflower protein isolate in the cookies were increased. Lorenz (1983) described the flavour of cookies as 'nutty' and 'very pleasant', when sunflower kernels at a level of 5 to 15 percent were used.

Data regarding mean width, thickness and spread factor of cookies containing different levels of wheat germ and sunflower kernels in the formulation are presented in Table 7. The cookie spread factor decreased with the addition of 0 to 30 percent of wheat germ as well as sunflower

Table 6. Mean sensory scores for cookies containing different levels of sunflower kernel in the formulation.

Level of sunflower kernel (%)	Top grain	Texture	Flavor	Overall Acceptability
0	5.0	4.0	4.0	4.30
5	5.0	5.0	5.0	5.00
10	5.0	5.0	6.0	5.33
15	5.0	6.0	6.0	5.67
20	5.0	6.0	6.0	5.67
25	4.0	5.0	6.0	5.00
30	3.0	5.0	6.0	4.70
F ratio at 0.05% level of significance	1.73 N.S.	4.46*	3.00 N.S.	4.59*
Least significant difference		2.09		1.51

N.S. = Non-significant.

Table 7. Mean width, thickness and spread factor of cookies containing different levels of wheat germ (WG) and sunflower kernels (SFK).

Level of WG/SFG	Width (cm)		Thickness (cm)		Spread factor	
	WG	SFK	WG	SFK	WG	SFK
0	7.68	7.68	1.25	1.25	6.14	6.14
5	7.70	7.41	1.26	1.30	6.11	5.70
10	7.78	7.42	1.29	1.33	6.03	5.58
15	7.80	7.45	1.30	1.33	6.00	5.60
20	7.77	7.23	1.31	1.32	5.93	5.48
25	7.72	7.02	1.31	1.33	5.89	5.28
30	7.45	6.95	1.31	1.36	5.69	5.11
F value ( $P = 0.05$ )	27.76	150.99	1.81 N.S.	3.98 N.S.	380.08	3967.84
Least significant difference	0.145	0.14	-	-	0.05	0.03

N.S. = Non-significant.

kernels in the formulation. Claughton and Pearce (1989) also reported reduced spread factor with increased levels of sunflower protein isolate in the cookie formulation.

### Conclusion

From the forgoing discussion it can be concluded that excellent cookies can be made using wheat germ and sunflower kernels as nutritional supplements, thus making cookies an attractive snack for the school feeding programmes, elderly and other vulnerable sections of the population. But these cookies have a tendency to become rancid, unless properly packaged and stored. With the recent developments in packaging films, the shelf-life of cookies can easily be extended to desirable time lengths. It is recommended that nutritious cookies can be prepared by replacing wheat flour with sunflower kernels or wheat germ up to a level of 20 percent without adversely affecting the overall acceptability of the product.

### References

- AACC (1983) Cereal laboratory methods. American Association of Cereal Chemists, Inc., St. Paul, Minn. 8th edn.
- AOAC (1980) Official Methods of Analysis. Association of Official Analytical Chemists, Washington, D.C. 13th edn.
- Bressani R, Elias LG (1968) Adv Food Res 16: 1
- Burns EE, Talley LJ, Burnett BJ (1972) Cereal Today 17: 287
- Claughton SM, Pearce RJ (1989) J Fd Sci 54(2): 354
- Duncan DB (1955) Biometrical 11: 1



- Earle FR, Vanetten CH, Clarke JF, Wolff IA (1968) *J Am Oil Chem Soc* 45: 876
- Jedrýszek L (1987) *Przeegląd Zbozowo Muynaiski* 31(3): 9
- Lorenz K (1978) *Bakers Digest* 52(4): 28
- Lorenz K (1983) *Cereal Foods World* 28(2): 449
- Narayana Rao M, Swaminathan MS (1970) *World Rev Nutr Diet* 2: 106
- Scrimshaw NS, Behar M (1959) *Fed Proc Fed Am Soc Exp Biol* 18 Suppl. 3: 82
- Shurpalekar SR, Haridas Rao P (1977) *Advances in Food Research* 23: 198
- Wan PJ, Baker GW, Clark SP, Matlock SW (1979) *Cereal Chem* 56(4): 352