

Supplementation of fermented sorghum bread (*kisra*) with dehulled and defatted sesame flour

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ABSTRACT

In this study, dehulled sesame seeds obtained from Mamoun Elberier factory were defatted by solvent extraction to produce a dehulled and defatted sesame flour (DDSF). Proximate analyses were determined on both the dehulled sesame flour and dehulled and defatted sesame flour. The results indicated that there was an increase in the contents of protein, moisture, fiber and carbohydrates due to the defatting process. Flour obtained from the dehulled and defatted sesame seed was used to supplement staple Sudanese baked product sorghum *kisra*, in the ratios of 10%, 20% and 30%. The various replacement ratios resulted in an increase in the protein content of the *kisra* from 12.25% in control *kisra* to about 15.75%, 19.49%, and 23.20%, respectively. The above replacement ratios also resulted in a concomitant increase in the *in-vitro* protein digestibility of *kisra* breads. The sensory analysis indicated that there were no significant difference between *kisra* bread made from the various blends of sorghum and DDSF. However, panelists gave higher scores to the 10% sesame/sorghum supplemented *kisra* than the *kisra* made from the other ratios. Nutritional value of *kisra* can be enhanced by the addition of DDSF at a level of up to 30%.

INTRODUCTION

Kisra is the staple Sudanese diet. It is a morsel or piece of bread prepared from fermented sorghum flour (Abdel Gadir and Mohamed, 1983). It provides most of the dietary proteins and energy in some parts of Sudan especially the rural areas, however, nowadays most urban people depend upon wheat bread as stable diets. It is baked traditionally by the housewife and also at the industrial level, although the latter is still limited. *Kisra* is probably the thinnest staple bread of the entire world. The baking time for each sheet of *kisra* is 15 – 20 seconds (Dirar, 1993). *Kisra* is consumed while still fresh. The average values for the composition of *kisra* as reported by many investigators are: 50% moisture, 30–40% carbohydrates, 12% protein, 2% crude fiber and 1.5% ash (El- Tinay *et al.*, 1985; Dirar, 1993).

Sesame (*Sesamum indicum*L.) is one of the world's oldest oil seeds. Several historians indicated that sesame originated in the central area of Ethiopia, from there, it was introduced to India and China (Yermanos, 1980).

Sesame cake is rich in protein, calcium, phosphorus and niacin. Several reports indicate that sesame proteins are rich in sulphur containing amino acids particularly methionine and cysteine (Smith, 1971; Johnson *et al.*, 1979; Narasinga, 1985). The dehulled and defatted meal can be used in food products as a protein and methionine supplement (Weiss, 1983).

In the Sudan, sesame is very important both for local consumption and for export. Locally, oil is extracted by expeller or by traditional wooden mills, driven by camels. Seeds are ground with sugar to form *tahniya*. The seed cake which locally known as “*umbaz*” is a good animal feed. Sesame oil is used in food industry, because of its excellent cooking quality, flavor and stability. The meal is a superior source of protein. Other minor uses of sesame oil are in preparation of antioxidants, cosmetics, and medicinal formulations (Yermanos, 1980). Keeping this in view, the objective of this study was to improve the nutritional value of *kisra* by supplementing it with various levels of DDSF.

MATERIALS AND METHODS

Seeds of dehulled sesame flour obtained from Mamon Elberir were defatted by solvent extraction with n-hexane. Sorghum seeds (Tabat variety) were obtained from Wad Medani local market.

Proximate analyses

Proximate analyses were carried out on samples consisting of dehulled sesame flour, dehulled and defatted sesame flour and *Tabat* sorghum flour obtained from decorticated *Tabat* sorghum and *kisra* supplemented with various levels of dehulled and defatted sesame flour. The percent-ages of moisture and protein were determined using the A.A.C.C methods (1983), while the oil, crude fiber and ash were determined according to A.O.C.S. (1985).

Preparation of the control and the supplemented samples

In the control sample, 1000 grams of sorghum flour were mixed with 2000 ml of water in a round earthenware container (*Khumara*), previously fermented dough (300 gm) was added to the mixture

of flour and water to act as a starter. In the supplemented samples, 10%, 20% and 30% of DDSF were used to supplement sorghum flour in such a way that dough contained a total of 1000 gram sorghum and sesame seed flour. Two thousands of water and 300g of starter were then added. The various samples were allowed to ferment for 18 hours at 32C°.

Dough analysis

All the prepared dough samples were analyzed for pH, total titratable acidity (T.T.A) and total soluble solids (T.S.S.) before and after the fermentation period. The pH was determined using the pH meter, total titratable acidity was determined by titration and T.S.S was determined using the hand refractometer.

Kisra baking method

Kisra was baked traditionally according to the method described by Dirar (1993) with slight modifications. An electrical plate (*Saj*) was heated to 160°C. A small amount of fermented dough (84 g) was spread on the hot plate into a thin sheet which was peeled off the plate after about 10 seconds of baking. The produced *kisra* sheets were stacked one over the other and was ready for further analysis.

Taste panel

A panel of 10 members composed of male and female adults was used to judge the quality of the different types of *kisra* supplemented with various levels of dehulled and defatted sesame seed flour, as well as the non-supplemented *kisra* (control). The panelists were asked to evaluate each sample for color, flavor, texture and overall acceptance using a scale of 1 to 9 as follows: 1, extremely bad; 2, very bad; 3, bad; 4, fairly bad; 5, satisfactory; 6, fairly good; 7, good; 8, very good; 9, excellent. The order of presentation of the various samples was randomized and given codes before being tested by the panelists.

Statistical analysis

The results obtained from the hedonic scale were statistically analyzed and subjected to Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Proximate analysis of the sorghum seeds and the dehulled and defatted sesame seeds showed that the protein and ash contents of the dehulled and defatted sesame flour were higher than that of sorghum while the moisture and carbohydrates contents were lower (Table 1).

Table 1. Chemical composition of sorghum and dehulled and defatted sesame flours.

Component (%)	Sorghum	Dehulled and defatted sesame
Moisture	6.8 ± 0.9	3.56 ± 0.35
Protein	10.5 ± 0.0	42.00 ± 1.75
Oil	3.43 ± 0.2	0.00
Crude fiber	1.39 ± 0.5	ND
Ash	1.82 ± 0.02	5.78 ± 0.27
Carbohydrate	75.9 ± 1.6	48.65 ± 1.30

ND: Not determined

The moisture content reported in this investigation for the DDSF was (3.56 ± 0.35%), which is lower than that reported by Ali (2000) who found a moisture content of 5.8%. This variation in moisture content could be attributed to the variation in environmental conditions. The estimated

value of ash content ($5.78 \pm 0.27\%$) was lower than the value of 13.5% reported by Sabah Elkheir (1994). On the other hand, the values of ash was higher than the value of 5.5% reported by Mohammed (2005). These variations could be due to the agronomic practices, the variety, or the soil conditions. The carbohydrate content was ($48.65 \pm 1.3\%$) which was generally in agreement with the value of 45.85 reported by Mohammed (2005). The protein content ($42.00 \pm 1.57\%$) was slightly lower than that obtained by Sabah Elkheir (1994) who reported 44% protein content of DDSF. It was reported that sesame protein had a high biological value due to the presence of all essential amino acids including lysine and sulphur-containing amino acids, particularly methionine in appreciable amounts (Rao and Rao, 1981). The pH of all fermented samples was slightly lower than that of the non-fermented samples (Table 2). This drop in pH was accompanied with an increase in titratable acidity. This increase in acidity has a definite effect on production of very thin *kisra* sheets. An explanation of this was given by Novellie (1982) who stated that the acid produced by fermentation softens the protein matrix so that the fermented dough becomes more coherent and can easily be spread out in very thin sheets. The estimated total soluble solids were higher in the supplemented dough samples.

Table 2. pH, total titratable acidity (T.T.A) and total soluble solids (T.S.S) contents of control, fermented (F) and non-fermented (NF) supplemented doughs.

Kind of <i>kisra</i>	pH		Total titratable acidity (%)		T.S.S (%)	
	F	NF	F	NF	F	NF
Control	2.69	4.25	1.80	0.35	5.40	7.00
10% DDSF	2.65	4.18	2.25	0.40	5.60	7.50
20% DDSF	2.53	4.14	2.37	0.56	5.90	8.00
30% DDSF	2.50	3.95	2.49	0.67	6.40	8.2

The moisture contents of the supplemented *kisra* breads (Table 3) decreased as a result of sesame addition. The most significant effect of sesame supplementation of *kisra* was the improvement in protein content. The crude fiber contents progressively increased with the increase in the supplementation level similar to that of the control unsupplemented sample.

Table 3. The chemical composition of dehulled and defatted sesame flour supplemented *kisra* and their *in vitro* protein digestibility.

Kisra kind	Moisture	Protein	Percentage of		Ash	Carbohy- drate	<i>In vitro</i> protein digestibility
			Oil	Crude fiber			
Control	52.50	12.25	3.48	3.40	1.56	26.81	78.93
10% DDsf	50.01	15.75	3.20	5.34	1.83	23.67	79.67
20% DDsf	47.62	19.49	2.70	7.10	2.30	20.79	82.99
30% DDsf	45.92	23.20	2.33	8.21	2.50	17.84	83.92

There was an increase in ash content (1.56 – 2.50%) (Table 3) due to the increase in the addition of sesame flour. The carbohydrates content of the control sample (26.81%) was higher than those of the supplemented *kisra*. This drop could be due to the reduction in the amount of sorghum flour in these formulations. The increase in the replacement ratio of sesame flour led to the increase in the protein digestibility of the sorghum bread from 78.93% to 83.92%.

The mean scores for sensory attributes of the various percentages of the dehulled and defatted sesame flour supplemented *kisra* was shown in Table 4. The data indicated that there were no significant differences between treatment in all the sensory attributes measured ; thus the preference of control *kisra* was similar as that of *kisra* supplemented with 10%, 20% and 30% dehulled and defatted sesame flour. However, for nutritional purposes, it is advisable to add dehulled and defatted sesame flour at a level of up to 30% in the manufacture of *kisra* bread

Table 4. Mean scores for sensory attributes of control unsupplemented *kisra* and *kisra* supplemented with different levels of dehulled and defatt-ed sesame flour .

Kind of <i>kisra</i>	Colour	Flavour	Texture	Overall acceptance
Control <i>kisra</i>	7.9	6.6	6.8	6.4
10% DDsf	6.7	7.3	7.1	7.2
20% DDsf	7.5	6.8	7.0	7.1
30% DDsf	6.8	6.1	5.8	6.1

Means based on 9 points scale (9 = excellent, 1= extremely bad).

There are no significant differences between treatment means in all the sensory attributes measured and hence the lettering system is not used to indicate significance level.

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تدعيم خبز الذرة المخمرة (الكسرة) بدقيق السمسم المقشور والمنزوع الدهن

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الخلاصة

أجريت هذه الدراسة باستخدام السمسم المقشور الذي تم جلبه من مصانع مأمون البربر حيث تم استخلاص الدهن منه بالمذيب العضوي لإنتاج دقيق السمسم المقشور والمنزوع الدهن. تم إجراء التحليل التقريبي لعينتين من السمسم الأولي دقيق السمسم المقشور فقط والثانية دقيق السمسم المقشور و المنزوع الدهن. أوضحت النتائج زيادة في المكونات الكيميائية التي تشمل البروتين والرطوبة والألياف والكاربوهيدريت نتيجة لعملية نزع الدهن. الدقيق الناتج من عينه السمسم المقشور والمنزوع الدهن تمت إضافته إلى دقيق الذرة لصناعة الكسرة بنسب مختلفة 10% ، 20% و 30% مما نتج عنه زيادة محتوى البروتين في الكسرة من 12.25% إلى 15.75% ، 19.49% و 23.2% على التوالي ، نسب السمسم المقشور والمنزوع الدهن السابقة أدت إلى زيادة في هضمية البروتين مصاحبة للزيادة في البروتين. لقد أوضح التحليل الحسي عدم وجود اختلاف معنوي بين مختلف أنواع الكسرة إلا أن المحكمين قد أعطوا درجة قبول أعلى نسبياً للكسرة المصنعة من دقيق الذرة المحتوية على 10% من دقيق السمسم مقارنة بالكسرة المصنعة من دقيق الذرة المحتوية على 20% و 30% من دقيق السمسم. لا اعتبارات تغذوية يمكن إضافة دقيق السمسم المقشور والمنزوع الدهن بنسبة تصل إلى 30% في صناعة الكسرة.