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Effect of Some Drying Methods on Nutritional and Technological Qualities of Extruded Flour Blend product

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ABSTRACT

This study was carried out to test the effect of drying under sun and shade before frying on the nutritional and t% reported technological quality of extruded flour blend. Blend of wheat flour and corn starch was subjected to analysis of chemical composition before processing to detect the effect of processing (extrusion) and drying on the nutritional value. Extruded sample dried under sun reflected a moisture content of 9.46% and 11.57 for the sample dried under shade. Chemical composition of fried extruded sample dried under shade showed a significant increase compared with extruded sample dried under the sun. In addition the *in vitro* protein digestibility of extruded samples dried under shade gave a better result than the sample dried under the sun and both of them were better than the blend (extrusion effect). However, lysine (An essential amino acid) recorded 26.963 and 51.225 for samples dried under sun and shade, respectively. In general the extruded sample dried under shade had specific volume (expansion ratio) better than the sun dried sample. Sensory evaluation of the extruded sample dried under shade was found superior in taste, crispness and general acceptability.

Keywords: *extrusion – sun drying – shade drying.*

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INTRODUCTION

Cereals are the base of the human diet in most countries of the world. In fact, they provide most of the caloric energy and an important part of the proteins needed by human beings. Furthermore, there is evidence showing that healthy diets for humans should provide most of the calories as complex carbohydrates such as cereal starch (Dendy and Dobraszczyk, 2001). The most employed cereals in human food are wheat and rice, although barley, rye, oat, sorghum and corn are also important. Although carbohydrates are their main dietary contribution they also provide proteins and smaller amounts of lipids, fibre and vitamins.

Extrusion is a thermal processing that involves the application of high heat, high pressure and shear forces, to an uncooked mass, such as cereal foods (Riha, 1996). Extrusion cooking is an important and popular food processing technique and cereal grains are common ingredients in extruded products (Faraj, 2004). Extrusion of cereal-based products has advantages over other usual processing methods because of low cost, short time, high productivity, versatility, unique product shapes and energy savings (Faraj, 2004 and Farouk, 2000). The extrusion process results in a number of chemical changes that occur, including gelatinization of starch molecules, cross-linking of proteins and the generation of flavors (Riha, 1996).

Objective of this study

To compare the sun drying and shade drying effects on the nutritional value of the extruded product.

MATERIALS AND METHODS

Blends and samples preparation

The blends were prepared by adding 1.5kg of wheat flour and 1kg corn starch, Samples were prepared by adding tab water till well wetted , extruded by a machine model DLG 90 single screw, then cut into regular shapes, some of samples were dried under shade for 18 hours, at 30ºC and then fried . Other samples were dried under sun for 8 hours at 42 º C and then fried.

Chemical composition

Moisture, ash, crude protein, fat and carbohydrates were determined for samples (before and after frying) according to AACC (2000) method.

Calcium and Magnesium

Calcium (Ca) and magnesium (Mg) determination was carried out according to Chapman and Pratt (1961).

Phosphorus

Phosphorus determination was carried out according to Chapman and Pratt (1961) using CE 202 Ultraviolet spectrophotometer.

***In vitro* protein digestibility with pepsin**

The *in vitro* protein digestibility was determined for samples (before and after frying) by the method of Maliwal (1983) as modified by Manjula and John (1991).

Amino acids profile

Amino acids were determined using High Performance Liquid Chromatography (HPLC).

Physical tests

Volume of extruded samples

Twenty grams of each sample weighed, and then put in a measuring cylinder (500 ml), then the volume was read.

Sensory evaluation:

Extruded samples were assessed organoleptically by the ranking test according to the procedure described by Ihekoronye and Ngoddy (1985).

Statistical analysis procedure

Data generated was subjected to analysis using the statistical Package for Social Science (SPSS). Means were tested by analysis of variance (ANOVA), and then means were separated using Duncan's Multiple Range Test (DMRT) according to Mead and Gurnow (1983).

RESULTS AND DISCUSSION

Proximate composition of blends

Table (1) shows the results of proximate composition of extruded samples before frying.

Moisture content

Table (1) shows the moisture content of the test samples as 7.0%. Moisture content of starch before extrusion was an important factor controlling the expansion volume of starch (Chinnaswamy and Hanna, 1987). The results obtained are in agreement with Chinnaswamy and Hanna (1988) who reported the maximum expansion ratio was observed at the moisture content ranged 7.0 - 14.2% of starch, and decreased from 14.0 - 30.0%.

Ash content

The ash content of the test samples appears in Table (1). It was 0.54% for the wheat – corn blend. This result is in a good agreement with Zeleny (1971) who reported that the ash content of wheat flour is 0.52-0.55%.

Fat content

The fat content was 1.07% for samples. These results were lower than these obtained by Hassan (2007) who reported fat content of wheat flour as 1.33%.

Protein content

Table (1) show the protein content of sample as 6.01%. This value was lower than the value reported by Giami *et al*. (2005) and Haldore *et al*. (1982) who gave that the protein content of wheat flour as 11.3 and 10-16%, respectively. This decrease may be due to the addition of corn starch because there is negative relationship between starch and protein content.

Carbohydrates content

Carbohydrates content of sample 85.38% (Table 1)

Minerals content of blends

Table (1) shows the mineral content of blend. Calcium (Ca) content of the sample was 0.0200%.

Moisture content of the extruded samples after drying

The results of Table (2) show the moisture content of extruded samples after drying and before frying. The moisture content was 9.46% and 11.57% for sun dried and shade dried samples, respectively. These differences may be due to the differences of drying methods (sun and shade drying).

Proximate composition of extruded samples after frying

Table (3) shows the results of proximate composition of extruded samples after frying.

Moisture content of products

Moisture content of extruded samples illustrated in Table (1) as 4% for all samples dried using the two methods of drying (sun and shade drying) then fried. This result was lower than the moisture content of samples before frying, and that may be attributed to the very high temperature of frying oil, which has driven some of the moisture.

Ash content

Table (1) shows the ash content of extruded samples after frying as 2.15 for the sample dried under sun. Sample dried under shade then fried gave result as 2.64.

Fat content

Fat content of extruded samples after frying was obtained in Table (1) as 23.21 and 23.37% for the samples dried by the two methods of drying (sun and shade), respectively. These high values of fat may be attributed to frying treatment where samples absorbed a quantity of oil.

Protein content

Table (1) shows the protein content of extruded samples after frying as 5.41% for sun dried sample. This result was lower than sample dried under shade, which recorded 5.44.

Carbohydrates content

Results of carbohydrates of the extruded samples, after frying, were shown in Table (1) as 64.74% for sun-dried sample and 65.04% for sample dried under shade.

Minerals content

The results of the mineral content of extruded samples after frying are shown in Table 1. That is, Calcium (Ca) content was 0.0201% in sun-dried sample and 0.0203 in shade dried sample.

Magnesium (Mg^{++}) was recorded 0.0102 and 0.0120 and Phosphorous content was 0.00216 and 0.00223for sun dried and shade dried, respectively.

It has been observed that samples dried under shade had higher minerals content than samples dried under sun, and this might be due to the direct correlation between the ash and the minerals content.

In vitro protein digestibility

In vitro protein digestibility of blend and extruded samples are illustrated in Table (3).

Extrusion cooking has enhanced in vitro protein digestibility, the blend sample before extrusion obtained 23.50, extruded samples dried under sun obtained value 23.60. In sample dried under shade in vitro protein digestibility value was 23.63.

The results agree with Bishnoi and Khetarpaul (1993) and Chau and Cheung (1997) who reported that the extrusion cooking produced a more significant improvement of in vitro protein digestibility and in vitro starch digestibility in faba and kidney beans.

Amino acids content of samples after frying

Table (4) show the contents of amino acids for samples after frying in mg/100 g. Tryptophan is an essential amino acid, but it was not determined as it is not stable in acid hydrolysis. Lysine recorded 51.225 mg/100 g for the sample dried under shade; and 26.93 for the sun-dried sample.

Therionine, leucine and isoleucine were increased in extruded samples dried under shade when compared with sun dried sample. Generally, sun drying lowered the levels of amino acids in samples compared with samples dried under shade. This may be attributed to the high temperature of sun-drying.

Physical tests

Volume of extruded samples

Better specific volume was recorded in sample dried under shade than this dried under sun, this may be due to the higher moisture content of sample dried under shade (11.57) resulting by drying compared with samples dried under sun (9.46%) table (5).

Sensory evaluation of extruded samples

Results of sensory evaluation of extruded samples were summarized in Table (6). The results showed significant differences ($P \leq 0.05$) among the samples dried by the two methods of drying (sun and shade) in taste, colour crispness, flavour and General acceptability.

In general, all samples dried under shade gave high scores in all sensory characteristics.

Table 1. Proximate composition of the flour blend and the extruded samples

Samples	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	CHO (%)	Ca (%)	Mg (%)	P (%)
B	7.0 ± 0.00^a	0.54 ± 0.00^e	1.07 ± 0.00^f	6.01 ± 0.01^g	85.38 ± 1.01^a	0.0200^a	0.0080^a	0.00095^a
SD	4.0 ± 0.00^b	2.15 ± 0.00^a	23.21 ± 0.18^a	5.41 ± 0.01^j	64.25 ± 0.43^i	0.0201^a	0.0102^a	0.00216^a
SH	4.0 ± 0.00^b	2.64 ± 0.00^b	23.37 ± 0.29^d	5.44 ± 0.01^i	65.04 ± 00.08^e	0.0203^e	0.0120^e	0.00223^e

Any two mean±S.D values having different superscript letters differ significantly ($P \leq 0.05$).
B: Blend of wheat flour and corn starch
SD: Sun dried extruded sample
SH: Shade dried extruded sample

Table 2. Moisture content (%) of extruded samples after drying and before frying

Samples	Moisture content (%)
SD	9.46 ± 0.01^c
SH	11.57 ± 0.02^b

Any two mean±S.D values having different superscript letters differ significantly ($P \leq 0.05$)
Samples:
SD: Sun dried extruded sample
SH: Shade dried extruded sample

Table 3. In vitro protein digestibility of blend and extruded samples

Sample	Protein digestibility %
B	23.50^a
SD	23.60^e
SH	23.63^i

B: blend of wheat flour and corn starch.
SD: Sun dried extruded sample.
SH: Shade dried extruded sample

Table 4. Amino acid content of samples after frying (mg /100 gm)

Amino Acids	Aspartic acid	Therionine	Serine	Glutamic acid	Glycine	Alanine	Cystine	Valine	Methionine	Isoleucine	Leucine	Tyrosine	Phenylalanine	Histidine	Lysine	Ammonia
SD	105.900	74.963	90.525	249.763	76.425	165.413	-	161.425	38.363	133.150	242.525	-	121.475	59.425	26.963	392.438
SH	150.700	108.450	131.844	732.500	123.088	195.363	-	227.038	54.875	205.288	356.088	-	181.825	82.063	51.225	658.500

SD: Sun dried extruded sample
SH: Shade dried extruded sample

Table 5. Volume of fried extruded samples

Samples	Volume (cc^3)
SD	310±20.00^{cd}
SH	317±5.77^{bcd}

Any two mean±S.D values having different superscript letters differ significantly (P≤0.05).
SD: Sun dried extruded sample
SH: Shade dried extruded sample.

Table 6. Sensory evaluation of fried extruded samples

Samples	Taste	Colour	Crispness	Flavour	General acceptability
SD	7.0±1.89^{bc}	7.9±1.30^{a}	6.7±1.79^{cd}	6.9±1.81^{ab}	6.9±1.81^{b}
SH	7.8±0.43^{ab}	8.2±1.05^{a}	8.0±1.18^{ab}	7.8±1.12^{a}	8.1±0.86^{a}

Any two mean±S.D values within each column having different superscript letters differ significantly (P≤0.05).
SD: Sun dried extruded sample
SH: Shade dried extruded sample

CONCLUSION

Sun-drying has a negative effect on chemical composition (quality) of extruded sample. Sun-drying has a negative effect on volume and sensory quality of extruded samples. The physical characteristics of extruded samples dried under shade were superior to extruded dried under sun.

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