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Improvement of the Frying Quality and Storage Stability of the Sudanese Groundnut Oil

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Abstract: The improvement of the frying quality and storage stability of the groundnut oil by adding 30% palm olein were studied during the frequent frying and different storage periods: 12 days, 40 days and 96 days at room temperature (37±3°C). The physiochemical parameters used in this study showed significant ($p \leq 0.05$) changes in the viscosity of the ground oil and the oil blend during the frequent frying but after 40 days of storage the viscosity of the 2 samples was decreased and then increased by the end of the storage (96 days). Also the results showed significant ($p \leq 0.05$) increase in the free fatty acid during the frying and the three periods of storage. However the Peroxide Value (P.V) increased significantly ($p \leq 0.05$) during the 4th time of frying from 11.167 mqu/kg to 31.00 and from 11.933 to 21.200 for the groundnut oil and the oil blend respectively the increase in the (P.V) continued up to the end of the storage for the both samples but the oil blend recorded the lower values from 31.100 mequ/kg to 148.100 and from 21.867 to 41.100 for the groundnut oil and the oil blend respectively. On the other hand, the Polymer Content (P.C) of the 2 samples was found to increase significantly ($p \leq 0.05$) from 0.537-2.440% and from 0.437-1.383% for the groundnut and the oil blend respectively, these values during the frequent frying, wear as during the storage the P.C continued to increase till recorded 7.773% and 6.450% for the groundnut oil and the oil blend respectively in general, the results obtained in this study indicated that adding palm olein to the groundnut oil at a ratio of 70% groundnut oil 30% palm olein greatly improved the frying quality and storage stability of the latter oil.

Key words: Groundnut oil, palm olein, frying, quality, storage stability

INTRODUCTION

Groundnut oil, called peanut, monkey nut, or mani originated from South America but is also indigenous to West Africa, China, India and North America when derived from sound nuts, the oil is easily refined to give a pale yellow oil of pleasant, mild or bland flavour. The oil shows good resistance to oxidation it's fatty acid profile consists of about 20% saturated acid and 80% unsaturated ones.

Groundnut oil contains up to 30% linoleic acid, the essential fatty acid, which plays a major part in human diet (Ihekoronye and Ngoddy, 1985). Groundnut seeds are rich in oil (38-50%), which is used for cooking, salads, manufacture of margarine, soap and as lubricant. The high quality oil is used as well in pharmaceutical industry (Higgens, 1951). Groundnut seeds are also rich in protein and make a major contribution to human nutrition as they contain 30% digestible protein beside vitamin B and E seeds are consumed raw or roasted or crushed for preparation of groundnut paste and butter (Pueseglove, 1968). In Sudan, groundnut is considered one of the major oil sources and the crop continues to play an important role in the Sudan foreign trade (Arab Agricultural Statistics Yearbook, 2000).

The palm oil exists in a wild semi-wild and cultivated states in the three land areas of the equatorial tropics of Africa, South East Asia and America, palm oil is used in the manufacture of margarine, compound cooking fat, tin plate industry, soap industry and it is used much more for the manufacture of edible products (Hartley, 1977). Palm oil unlike other vegetable oils with a high linoleic acid content does not under go much oxidative damage at temperature of 180°C and hence can be used at home both for shallow pan frying and deep frying of potato chips. In the latter use, it was found suitable for re use several times and for blending with other polyunsaturated oils like groundnut oil which is a good practice, because the final oil blend has a better frying performance. Barger (1999) besides being marketed for use by it self as a liquid oil, palm oil could be promoted for blending with other edible oils for use in the food processing and for blending with a high polyunsaturated fatty acids content like soybean, rapeseed and groundnut oil which will help to reduce the high linoleic acid content of the latter oils to more acceptable level (Bagepolli and Narasinga Rao, 1994) their for, the main objective of this study was to improve the frying quality and storage stability of the groundnut oil by using a good saturated edible oil in order to reduce the high linoleic acid content of the oil mentioned above.

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MATERIALS AND METHODS

Refined groundnut oil was donated by Bitar Co. Ltd., Khartoum North, while palmolein was donated by the Sudanese oil seed company, Khartoum potato varieties (Alpha) used in the frying experiments were brought from local market.

Oil blend was prepared by mixing 70% groundnut oil and 30% palm olein. The pure groundnut oil and the blend were used to fry about pre hundred grams of potato slices for 8±2 min. The frying process was done in four successive days, almost equivalent to 8 frying times. After each frying experiment about 250 gm oil with drown, kept in analysis plastic containers till required for both samples of oils used in the frying stored at room temperature (37±2^{0}C) for 96 days divided into short, medium and prolonged storage periods.

The viscosity, Free Fatty Acid (F.F.A), Peroxide Value (P.V) were determined in oil samples according to Wali *et al.* (1995). While the polymer content was determined according to Peled *et al.* (1975). The viscosity of the samples was determined by using Ostwald-ll-tube viscometer (No.7647).

RESULTS AND DISCUSSION

Changes in viscosity free fatty acid, peroxide value and polymer content during the fourth time of frying and the three periods of storage are found in Table 1 and 2, respectively.

Table 1 shows significant ($p \leq 0.05$) changes in viscosity of oils during frying the increase in viscosity of oil blend was higher than groundnut oil till the 3rd time of frying. These results are found to be in a good agreement with those reported earlier by Eckey and Lawrence (1954); Erickson (1978); El Kabashi (2000).

Changes in free fatty acid of groundnut and the blend are also found in Table 1. The F.F.A increased significantly ($p \leq 0.05$) in both oils from 0.023-0.233 and from 0.023-0.157 for the groundnut oil and the blend respectively. However, the increase in the F.F.A of the groundnut oil was higher than the blend. The increase in the F.F.A during the frying was reported by Berger *et al.* (1989) and Affandi and Sahri (1999).

Significant ($p \leq 0.05$) changes are also observed in the peroxide value in Table 1. During the frequent use in frying of potato chips the P.V increased from 11.167-31.000 and from 11.933-21.200 for the groundnut oil and the blend respectively, but the rate of formation of peroxides was faster in the groundnut oil compared to the blend. The increase in PV of vegetable oils during frying was reported earlier by Fritisch *et al.* (1979) and recently by Yusoff *et al.* (2001).

Table 1 also shows significant ($p \leq 0.05$) increase in the polymer content of both samples from 0.537-2.440 for the groundnut oil and from 0.437-1.383 for the blend. The results obtained in this study agree well with those reported by Romero *et al.* (1995), Berger *et al.* (1989).

On the other hand, for the results in Table 2, significant ($p \leq 0.05$) increase in viscosity was noted in the 12 day of storage but a sudden decrease was clearly observed in the 40 days of storage in both samples from 79.033 in 12 day to 54.333 in 40 day storage and from 74.980 in 12 day to 54.367 in 40 day for the groundnut and the blend respectively. While in the 96 day of the storage the viscosity of all samples continued to increase for the second time. El Kabashi (2000) reported the increase in viscosity of vegetable oil and Eckey and Lawrence (1954) reported the relationship between temperature and decrease or increase in viscosity of edible oils.

Also Table 2 indicate the changing in free fatty acid during the three periods of storage, which was recorded a significant increase ($p \leq 0.05$) from 0.233-0.807 oleic and from 0.250-0.697 oleic for the groundnut oil and the blend respectively. The effect of the storage on F.F.A was reported by Chu (1991). Changes in the peroxide value of the groundnut oil and the oil blend were also found in Table 2. A significant ($p \leq 0.05$) increase was observed in all samples up to the end of the storage, but the P.V. of

Table 1: Changes in viscosity free fatty acid, peroxide value and polymer content of the groundnut oil and the blend during fourth time of frying*

No. of frying	Viscosity (c.p)		*FFA (% oleic or palmitic)		Peroxide value (mEq/kg)		Polymer content (%)	
	G.N.O	Blend 70-30	G.N.O	Blend 70-30	G.N.O	Blend 70-30	G.N.O	Blend 70-30
Zero	64.033^{b}±0.06	69.633^{a}±0.06	0.023^{d}±0.01	0.023^{e}±0.01	11.167^{e}±0.29	11.933^{c}±0.06	0.537^{e}±0.01	0.437^{d}±0.01
1st	66.533^{b}±0.06	71.167^{a}±0.29	0.023^{d}±0.01	0.053^{d}±0.01	20.033^{d}±0.06	19.167^{b}±0.29	1.023^{d}±0.01	0.547^{c}±0.05
2nd	71.030^{ab}±0.06	73.100^{ab}±0.01	0.083^{c}±0.01	0.083^{c}±0.01	25.167^{c}±0.29	20.033^{ab}±0.06	1.270^{c}±0.02	1.283^{b}±0.01
3rd	74.100^{a}±0.17	73.733^{ab}±0.06	0.140^{b}±0.05	0.123^{b}±0.02	29.133^{ab}±0.23	21.100^{a}±0.17	1.447^{b}±0.05	1.317^{ab}±0.03
4th	75.100^{a}±0.10	74.767^{a}±0.12	0.233^{a}±0.01	0.157^{a}±0.03	31.000^{a}±0.17	21.200^{a}±0.35	2.440^{a}±0.03	1.333^{a}±0.01

Mean±SD values bearing different superscript letters in a column are significantly different ($p \leq 0.05$). *Calculated as oleic for groundnut oil and as palmitic for the blend. FFA = Free fatty acid

Table 2: Changes in viscosity free fatty acid, peroxide value and polymer content of the groundnut oil and the blend during storage

Storage days	Viscosity (c.p)		*FFA (% oleic or palmitic)		Peroxide value (mEq/kg)		Polymer content (%)	
	G.N.D	Blend	G.N.D	Blend	G.N.D	Blend	G.N.D	Blend
Zero	75.667^{b}±0.06	74.767^{a}±0.12	0.233^{d}±0.01	0.250^{d}±0.00	31.100^{d}±0.17	21.867^{c}±0.06	2.633^{d}±0.06	1.530^{c}±0.02
12 days	79.033^{a}±0.06	74.980^{a}±0.00	0.400^{c}±0.00	0.407^{c}±0.01	39.167^{c}±0.29	27.167^{b}±0.29	4.483^{c}±0.01	2.447^{bc}±0.03
40 days	54.333^{d}±0.06	54.367^{c}±0.12	0.557^{b}±0.01	0.507^{b}±0.01	43.200^{b}±0.35	28.300^{b}±0.52	6.333^{b}±0.02	3.633^{b}±0.06
96 days	60.733^{c}±0.06	61.133^{b}±0.06	0.807^{a}±0.01	0.697^{a}±0.01	148.100^{a}±0.17	41.100^{a}±0.17	7.773^{a}±0.02	6.450^{a}±0.05

Mean±SD values bearing different superscript letters in a column are significantly different ($p \leq 0.05$). FFA = Free fatty acid

the groundnut oil was extremely high compared to the oil blend 148.10 and 41.10 for the groundnut oil and the blend, respectively. These results for the G.N.O and the blend respectively appear to be in good agreement with those reported by Gaing (1968) and Arya *et al.* (1969).

A significant ($p \leq 0.05$) increase in the polymer content of the both oil samples was reported in Table 2 from 2.633-7.773 and from 1.530-6.450 by the end of the storage for the groundnut oil and the oil blend respectively. Pokorny *et al.* (1975); Chu (1991) found an increase in PC of vegetable oils during storage.

Conclusion and Recommendations: From the results obtained in this study it can be concluded that the oil blend which was contain 70% groundnut oil and 30% palm olein was found to be with high quality and more stable than the groundnut oil during the frying and the 3 periods of storage. The oil blend recorded the lower values of viscosity free fatty acid, peroxide value and polymer content by the end of the frying and the end of the storage (96 days) compared to the groundnut oil however, the blend at a ratio of 70:30% was greatly found to improve the quality and stability of the groundnut oil.

Edible oils were found to differ in their thermal stability during frequent use in frying. Palm oil has become more available to the consumers and markets, therefore, blending this oil with conventional edible vegetable oils could markedly reduced their prices and improve their quality and stability.

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