



SAFETY AND QUALITY OF SOME VEGETABLE OILS MARKETED LOCALLY IN THE GOVERNORATE OF AL-HASA, SAUDI ARABIA

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Abstract. The aim of this research to identify the pattern of consumption of vegetable oils to families in the Governorate of Al-Hasa, Saudi Arabia, also, examining the safety and quality of some varieties vegetable oil marketed locally, and compare the results obtained from physical and chemical properties of eight oil samples with Saudi Arabia and International standard specification. Data were collected by the survey form was distributed to the housewife and the form included questions about the types of oils most often used in cooking and frying. The results obtained indicated that the oil most commonly used in cooked and frying foods is sunflower oil (*Noor brand*) (51.20% and 48.00%), respectively. On the other hand, the results of physical and chemical properties showed the significant differences between different kinds of oils. Also, there are significant differences in the values of oxidative stability, which ranged from 7.04 hr. for sunflower oil to 44 hr. for palm oil. Also, found that there were clear differences in the composition of fatty acids of oil samples, where results showed that predominant unsaturated fatty acids are linoleic acid or oleic acid and predominant saturated fatty acids is palmitic in most oil samples. Also, found that the percentage of *trans* fatty acids had reached 1.17 % and 5.66% in olive oil (*Al-Wazeir brand*) and oil (*Al-Arabi brand*), respectively. These percentages more than allowed in the Saudi Arabia and International standard specifications. While, mineral content of oil samples did not exceed the permissible limits according to the specifications.

Key words: Oils, fats, fatty acids, oxidative stability, *trans* fatty acids.

Introduction

Fats and oils are recognized as essential nutrients in both human and animal diets.

They provide the most concentrated source of energy of any foodstuff, supply essential fatty acids (which are precursors for important hormones, the prostaglandins), contribute greatly to the feeling of satiety after eating, are carriers for fat soluble vitamins, and serve to make foods more palatable [JOHNSON *et al.*, 2009]. Fats and oils are present in varying amount in many foods.

The principal sources of meats, dairy products, poultry, fish and nuts [WHO, 2003].

Most vegetable and fruits consumed as such contain only small amounts of fats.

Fatty acids are the building blocks of lipids and generally comprise 90% of the fats in that are of interest when reporting lipid content labelling of fats and oils.

Saturated fatty acids—hydrocarbon chains with single bonds between each of carbon atoms—found primarily in products derived from animal source (meat, dairy products) tend to raise the levels of low density lipoprotein (LDL) cholesterol in the blood [ELIAS *et al.*, 2001]. Unsaturated fatty acids—

characterized by one (monounsaturated) or more (polyunsaturated) double bonds in the carbon chain—are found mostly in plants and sea foods. Since the carbons are double bonds to each other, there are fewer bonds available for hydrogen, so there are fewer hydrogen atoms, hence "unsaturated".

Cis and *trans* are terms that refer to the arrangement of chains of carbon atoms the double bond [VOORRIPS *et al.*, 2002]. In the *cis* arrangement, the chains are on the same side of the double bond, resulting in a kinked geometry. In the *trans* arrangement, the chains are on opposite sides of the double bond, and the chain is straight overall [STRAYER, 2006].

Typically, common vegetable oils, including soybean, sunflower, safflower, mustard, olive, rice bran, sesame are low in saturated fats and the double bonds within unsaturated acids are in the *cis* configuration [BAKKER *et al.*, 1997]. To improve their oxidative stability and to increase their melting points, vegetable oils are hydrogenated. The process of hydrogenation is attended to add hydrogen atoms to *cis* unsaturated fats, eliminating a double bond and making them more saturated.

Full hydrogenation would produce exclusively saturated fatty acids that are too



waxy and solid to use in food production [STENDER, 2003]

Consequently, the process used by the industry does not eliminate all of the double bonds is called partial hydrogenation [GABROVSKA *et al.*, 2006]

Partially hydrogenated oils give foods a longer shelf life and more stable flavour.

However, the process frequently has a side effect that turns some *cis*-isomers into *trans*-unsaturated fats instead of hydrogenation them. The formation of *trans* fatty acids also occurs during deodorization step of processing, it is usually carried out at temperatures ranging from 180°C to 270°C.

Human intake of *trans* fatty acids originates from foods containing industrially produced, partially hydrogenated fat, and from beef, lamb and dairy products.

The *trans* fatty acids have unfavorable affection serum lipoprotein increased risk for cardiovascular and cerebrovascular diseases. They also decrease high density lipoprotein cholesterol levels [STENDER *et al.* 2003]

There is a mounting concern about the intake of foods containing *trans* fatty acids due to their deleterious effects on humans, although monounsaturated fatty acids is the main *trans* group ingested by most people, the presence of polyunsaturated *trans* fatty acids in significant levels has also been investigated in foods containing partially hydrogenated fats, fried food and refined oils [FRITSCHIE *et al.*, 1997].

The objective of this study was to identify the pattern of consumption of vegetable oils of the families of the Governorate of Al-Hasa Saudi Arabia and the types of oils more consumed.

Also, determine safety and quality of edible oil samples widely consumed in Saudi Arabia.

Material & methods

- *Sampling methodology*: Eight edible oil samples of different *brands* purchased from various markets in AL-Hasa, Saudi Arabia in the month of May 2009.
- *Physical and chemical properties of oils*: Refractive indexes, color, acid value, peroxide value, thiobarbituric acid, UV absorption at 232nm and 268nm and iodine number were determined according to the A.O.A.C. [A.O.A.C., 2005]
- *Trans fatty acids by Infra-red*

spectroscopy: *Trans* fatty acids in the oils were detected by using Shimadzu Fourier Transform Infrared 8101 PC Infra-red Spectrophotometer according to Nikolova [NIKOLOVA, 1992]. The solvent used was carbon-tetrachloride. Approximately 200mg of liquefied sample was accurately weighed into a 10ml measuring flask, dissolved in carbon tetrachloride and make up to volume. The absorption or transmission of the sample solution was measured against the reference solution (carbon tetra-chloride) in the 1050–900cm⁻¹ (9.50–11nm) rang, using the same instrument setting as in the calibration procedure. If at about 970cm⁻¹ (10.30nm) a straight line was draw between the adsorption minima at around 1000 and 925 cm⁻¹ (10.00–10.80nm).

- *Analysis of fatty acids*: The fatty acids of the oils were converted into methyl esters using diazomethane and identified by gas liquid chromatography according to the methods chromatography analysis using a Pyeunicam model PV 4550 capillary gas chromatography fitted with flame ionization detector, the column (1.5m X 4 mm) packed with diatomate C (100–120 mesh) and coated with 10 % polyethylene glycol adipate (PEGA). The column oven temperature was programmed at 8°C/min from 70°C to 190°C then isothermally at this temperature for 20 min and nitrogen flow rate was 30 ml/min. detector, injection temperatures, hydrogen and air-flow rates and chart speed were 300°C, 250°C, 33 ml/min. 330ml/min. respectively. The presented fatty acids were identified according to authentic samples of fatty acids chromatographer internal standards [FARAG *et al.*, 1985].
- *Oil stability*: Stability test was carried out using a 679 Rancimat apparatus (Metrohm Herisou, Switzerland) to 100°C±2°C and 20 L/hr. air flow [MENDEZ *et al.*, 1997]. The oil stability is expressed as the induction time (hr.) of hydroperoxide decomposition.
- *Analysis of mineral content*: The method of Puchyr & Shapiro was used [PUCHYR *et al.*, 1986]. This method consists of



char-ashing and digestion followed by analysis using atomic absorption spectrophotometer (Perkin Elmer 3300).

- *Statistical analysis:* Conventional statistical methods were used to calculate and standard deviations of three simultaneous assays carried out with the different methods. Analysis of variance (ANOVA) was applied to the data to determine differences ($P \geq 0.05$).

Results & dicussion

Table 1 shows the items most consumed vegetable oils for cooking in households in the Governorate of Al-Hasa Saudi Arabia and it shows that the sunflower oil is the most consuming, followed by corn oil then palm oil in food cooking.

Also the most items are *Noor brand* for sunflower oil (51.20%), followed by *Afia brand* for corn oil (38.40%) and *Al-Arabi brand* for palm oil (13.20%).

Table 1.

Types of vegetable oils more than used in cooking to families in the Governorate of Al-Hasa

Type of oils		Numbers	Percentage (%)
Sunflower oil	Noor brand	128.00	51.20
	Shams brand	3.00	1.20
	Other types	15.00	6.00
	Non-used	104.00	41.60
	Total	250.00	100
Corn oil	Afia brand	96.00	38.40
	Mazolla brand	15.00	6.00
	Other types	8.00	3.20
	Non-used	131.00	52.40
	Total	250.00	100.00
Palm oil	AL-Arabi brand	33.00	13.20
	Dalal brand	9.00	3.60
	Other types	12.00	4.80
	Non-used	196.00	78.40
	Total	250.00	100.00

Table 2 shows the items most commonly used vegetable oils for frying in households in the Governorate of Al-Hasa Saudi Arabia. It was found that sunflower oil (*Noor brand*) is the most commonly used in frying (48.00%), followed by corn oil is a little use in frying (16.00%).

Conducted pilot studies in some

places, Saudi Arabia to identify the types of oils the most consuming of the families Saudi, study by Al- Badr (2006) in Riyadh aimed at identifying the pattern of consumption of vegetable oils and found that oils the most intensive is the palm oil for frying, corn and sunflower oils for cooking and olive oil for salad.

Table 2.

Types of vegetable oils more than used in frying to families in the Governorate of Al-Hasa

Type of oils		Numbers	Percentage (%)
Sunflower oil	Noor brand	120.00	48.00
	Shams brand	3.00	1.20
	Other types	8.00	3.20
	Non-used	119.00	47.60
	Total	250.00	100.00
Corn oil	Afia brand	82.00	32.80
	Mazolla brand	11.00	4.40
	Other types	8.00	3.20
	Non-used	149.00	59.60
	Total	250.00	100.00
Palm oil	AL-Arabi brand	40.00	16.00
	Dalal brand	9.00	3.60
	Other types	15.00	6.00
	Non-used	186.00	47.40
	Total	250.00	100.00

Table 3 shows the physico-chemical properties of some vegetable oils under study.

The obtained data indicated that there are differences in some characteristics of oils.

Refractive index of oils varied between 1.4712 (sunflower oil) to 1.4616 (corn oil).

Also, there are clear differences in iodine value was found to be the highest values were (131.00) for the sunflower oil, while he lowest values were (58.00) for palm oil. These differences are due to differences in the fatty acids composition of oil and also the source of oil.

Generally, these values conform to the Saudi and international standard and Specifications, where International Standard Specifications no 210 (2009) have forced companies and factories producing oils and fats no more than about acid value 2% as oleic acid and peroxide value 10 milligrams peroxides /kg oil.

Table 3.

Physical and chemical properties of some vegetable oils.

Property	Afia C	Alaraby OL	Nour SUN	Alwazer OLO	Haly OL+C	Nakhletin OL+SUN+SO	Alaraby SUN+OL	Harvest CANOL
Refractive index at 25°C	1.4616±0.001	1.4643±0.001	1.4712±0.001	1.4665±0.002	1.4660±0.001	1.4663±0.002	1.4689±0.003	1.4700±0.001
Color at yellow 35	2.30±0.10	3.50±0.32	0.60±0.01	3.40±0.31	1.50±0.30	1.40±0.25	1.80±0.045	1.20±0.10
Acid value (% as oleic acid)	0.051±0.001	0.049±0.001	0.29±0.03	0.17±0.02	0.052±0.001	0.048±0.01	0.054±0.01	0.054±0.001
Peroxide value (meq./kg oil)	2.46±0.10	2.31±0.10	5.55±0.30	4.85±0.25	2.01±0.20	2.32±0.10	5.00±0.90	3.52±0.15
TBA at 532 nm	0.024±0.10	0.023±0.02	0.250±0.01	0.233±0.10	0.022±0.001	0.024±0.01	0.256±0.01	0.132±0.001
Conjugated diene at 232nm	0.015±0.10	0.013±0.01	0.226±0.01	0.210±0.10	0.012±0.01	0.014±0.01	0.223±0.01	0.142±0.01
Conjugated triene at 286nm	0.010±0.10	0.009±0.01	0.119±0.01	0.101±0.01	0.100±0.02	0.100±0.001	0.113±0.02	0.165±0.01
Iodine number (Hanus)	119.00±3.00	58.00±1.20	68.00±1.51	86.00±1.90	96.00±2.00	101.00±2.20	99.00±1.98	120.00±2.90

Data presented as mean ± S.D (Significant differences P <0.05) each one of triplicate

Table 4 shows the oxidative stability of vegetable oils by Rancimat method at 100°C±2°C.

The obtained results indicated that the highest values in the oxidative stability was

(44.00 hrs.) for vegetable oil brand *Al-nkhletin* (mixture palm olein+sunflower oil+soybean oil), while the lowest values were (7.04 hrs.) for *Noor brand* sunflower oil.

Table 4.

Oxidative stability of some vegetable oils by Rancimat method at 100°C.

Type of oils	Oxidative stability (hrs)
Afia C	14.84±2.10
Alaraby OL	32.20±3.15
Nour SUN	7.04±0.95
Alwazer OLO	38.40±3.51
Haly OL+C	39.00±3.91
Nakhletin OL+SUN+SO	44.00±4.10
Alaraby SUN+OL	8.40±1.10
Harvest CANOL	9.80±1.25

Data presented as mean ± S.D (Significant differences P <0.05) each one of triplicate

This difference in the values of oxidative stability may be due to the fatty acids composition and natural antioxidants content of oils.

The results of determination of fatty

acids composition by gas chromatography in vegetable oil samples indicated that there were clear differences (Table 5) in the fatty acids composition of oils.

Table 5.

Fatty acid composition of some vegetable oils by GLC

Name of fatty acids.	Afia C	Alaraby OL	Nour SUN	Alwazer OLO	Haly OL+C	Nakhletin OL+SUN+SO	Alaraby SUN+OL	Harvest CANOL
C4:0	0.13±0.01	0.13±0.01	0.00±0.00	0.00±0.00	0.18±0.01	0.19±0.01	0.00±0.00	0.00±0.00
C6:0	0.09±0.001	1.08±0.30	0.00±0.00	0.96±0.10	0.72±0.10	0.75±0.10	0.12±0.01	0.28±0.01
C8:0	0.02±0.001	0.62±0.10	0.05±0.001	0.09±0.001	0.23±0.01	0.23±0.01	0.43±0.01	0.48±0.01
C10:0	0.06±0.001	0.11±0.01	0.03±0.001	0.14±0.01	0.36±0.01	0.41±0.01	0.30±0.01	0.87±0.10
C12:0	0.27±0.01	0.30±0.01	0.10±0.01	1.37±0.30	0.19±0.01	0.34±0.01	0.15±0.01	2.80±0.20
C14:0	0.33±0.02	0.35±0.01	0.14±0.01	0.39±2.30	2.18±2.00	0.37±0.01	2.52±0.20	1.65±0.15
C16:0	11.35±2.30	35.45±3.45	7.25±1.10	11.69±0.10	29.61±4.60	28.74±4.50	19.72±2.53	5.61±0.46
C18:0	2.06±0.10	3.92±0.20	4.08±0.90	1.82±8.20	6.34±2.00	4.12±0.40	4.02±0.41	2.01±0.17
C18:1	28.76±4.55	44.03±5.22	26.94±2.11	74.04±8.20	37.23±5.52	41.67±5.00	28.45±4.31	56.26±8.01
C18:2	56.11±6.30	13.83±2.46	61.10±7.21	7.11±2.10	20.33±3.00	21.97±2.98	33.80±4.91	22.29±3.02
C18:3	0.77±0.20	0.17±0.01	0.26±0.01	0.59±0.01	0.56±0.10	1.16±0.20	0.15±0.01	7.67±2.01

Data presented as mean ± S.D (Significant differences P <0.05) each one of triplicate.

The predominant unsaturated fatty acids in corn oil (*Afia brand*) in linoleic acid (56.16 %), while, saturated fatty acid is palmitic acid (11.35%).

Palm olein (*Al-Arabi brand*), results showed that the predominant unsaturated fatty acids are oleic acid (44.03%), followed by linoleic acid (13.83%), while the major



saturated fatty acids is palmitic acid.

It is through the results in *Table 5* found that sunflower oil (*Noor brand*) was major unsaturated fatty acids is linoleic acid (61.10%), followed by oleic acid (26.94%), while, major saturated fatty acids is palmitic acid (7.25%), followed by stearic acid (4.08%).

Oleic acid was predominant in olive oil (*AL-Wazier brand*) (74.04%), followed by saturated fatty acids are palmitic acid (11.69%), followed by stearic acid (1.82%).

Also, oleic acid was predominant in oil *Hali brand* (mixture of palm olein+corn oil), followed by linoleic acid (20.32%), and while major saturated fatty acids is palmitic acid (29.61%).

It was also found that the predominant unsaturated fatty acids in oil *Alnnkltten brand* (mixture of olein+sunflower oil+soybean oil)

is oleic acid (47.67%), followed by linoleic acid (21.97%). Linoleic acid was predominant in oil *Al-Arabi brand* (mixture of olein+sunflower oil) (33.80%), followed by oleic acid (28.45%). Oleic acid was predominant in canola oil (*Harvest brand*) (56.26%), followed by linoleic acid (22.29%) and linoleic acid (7.67%). The levels of these fatty acids were within the range specified in the codex standard.

Table 6 shows the percentage of *trans* fatty acids of oil samples by infrared.

The results obtained indicated the presence ratios of these acids in some samples. *Trans* fatty acids of olive oil (*AL-Wazier brand*) is 1.37%, while oil (*Al-Arabi brand*) was 5.66% these percentages more than the permissible limits in the Saudi and International specifications.

Table 6.

Trans fatty acids composition of some vegetable oils.

Type of oils	% <i>Trans</i> fatty acids
Afia C	0.00±0.00
Alaraby OL	0.00±0.00
Nour SUN	0.00±0.00
Alwazer OLO	1.37±0.30
Haly OL+C	0.422±0.15
Nahkletin OL+SUN+SO	0.00±0.00
Alaraby SUN+OL	5.66±1.00
Harvest CANOL	0.00±0.00
Data presented as mean ± S.D (Significant differences P <0.05) each one of triplicate.	

Table 7 shows the mineral content of oil samples by Atomic Absorption Spectrophotometer Technique.

The results indicated that the mineral content of the oil samples was identical to the

Saudi and International Standard Specifications.

Which did not exceed the permissible limits according to the specifications.

Table 7.

Minerals content of some vegetable oils.

Mineral	Oils							
	Afia C	Alaraby OL	Nour SUN	Alwazer OLO	Haly OL+C	Nahkletin OL+SUN+SO	Alaraby SUN+OL	Harvest CANOL
Fe	0.05±0	0.03±0	0.06±0	0.04±0	0.01±0	0.02±0	0.03±0	0.04±0
Cu	0.003±0	0.001±0	0.002±0	0.001±0	0.001±0	0.10±0	0.01±0	0.03±0
Pb	0.001±0	0.001±0	0.001±0	0.01±0	0.01±0	0.002±0	0.01±0	0.02±0
Hg	0.00±0	0.00±0	0.00±0	0.00±0	0.001±0	0.00±0	0.01±0	0.00±0
Zn	0.05±0	0.04±0	0.03±0	0.01±0	0.02±0	0.01±0	0.02±0	0.02±0
Cd	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0
Al	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0
Ni	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0	0.00±0
Data presented as mean ± S.D (Significant differences P <0.05) each one of triplicate.								



Conclusions

Finally, the results of physico-chemical properties and fatty acids composition indicate that the samples of oil under study of high quality, but some oils contain a high percentage of *trans* fatty acids.

Therefore, the study recommends no consumption of these oils to preserve the general health of the consumer.

References

1. Bakker, N.; Van't Veer, P.; Zock, P. L. and the Euramic Study Group. (1997): Adipose fatty acids and cancers of the breast, Prostate and colon: An Ecological Study. *Int. J. Cancer*. 72: 587–597.
2. Elias, S. L. and Innis, S. M. (2001): Infant plasma *trans*, *n*-6, and *n*-3 fatty acids and conjugated linoleic acids are related to maternal plasma fatty acids, length of gestation, and birth weight and length. *Am. J. Clin. Nutr*, 73: 807–814.
3. Fritsche, J. and Steinhart. (1997): Contents of *trans* fatty acids (TFA) in German foods and estimation of daily intake. *Lipid*, 99: 314–318.
4. Johnson, S. & Saikia, N. (2009): Fatty acids profile of edible oils and fats in India. *Centre for Science and Environment*, 1: 3–31.
5. Stender, S. and Dyerberg J. (2003): The influence of *trans* fatty acids on health. A report from Danish Nutrition Council, Fourth Edition.
6. Strayer, D. (2006): Food Fats and oils. Publication by Institute of Shortening AND Edible oils 175 New York Avenue, NW. Suite 120 Washington, DC. 9th Edition.
7. Voorrips, L. E.; Brants H. A. M.; Kardinaal, A. F. M.; Hiddink, G. J.; Van den Brandt, P. A. and Goldbohm, R. A. (2002): Intake of conjugated linoleic acid, fat, and other fatty acids in relation to postmenopausal breast cancer: the Netherlands Cohort Study on Diet and Cancer. *Am. J. Clin. Nutr.*, 76: 873–883.
8. WHO, (2003): Diet, nutrition and the prevention of chronic disease. WHO Technical Report. Series 916.
9. Gabrovska, M.; Krstic, J.; Edreva–Kardjieva, R.; Stankovic, M. & Jovanovic, D. (2006): The influence of the support on the properties of nickel catalysis for edible oil hydrogenations. *Applied Catalysis A: General*, 299: 73–83.
10. O. A. C. (2005): Official Method of Analysis Association of Official Agricultural Chemists. 18th Ed. Washington, DC, USA.
11. Nikolova, B. (1992): Silver ion chromatography and lipids. In *Advances in lipid Methodology—one*, Edited by W. W. Christie, Oily Press Ltd., Agr., Pp. 181–237.
12. Puchyr, R. F. & Shapira, R. (1986): Determination of trace elements. *J. Assoc. Off. Anal. Chem.* 69; 860–870.
13. Mendez, E.; Sanhueza, J.; Speisky, H. & Valenzuela, A. (1997): Comparison of Rancimat evaluation modes to assess oxidative stability of fish oils. *J. Am. Oil Chem. Soc.* 74: 331–332.
14. Farag, R. S.; Abdel Rahim, E. A.; Ibrahim, N. A. & Basuny, A. (1985): Biochemical studies on the unsaponifiable of wheat kernel, soybean and sesame seeds infected by some fungi. *Grasses Y. Aceites*, 6: 368–372.
15. Al-Badr, A. & Abdallah, N. (2006): Fatty acid composition and pattern consumption of vegetable oils, *Journal Arabic Food Nutrition* 7:43–5.
16. International Standard Specifications (2009): Specification No. 210 for Vegetable Oils and Fats.

Received: June 7, 2011
Accepted: October 2, 2011

