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Research Article

Effect of Storage Period on Quality Parameters of Brand Oils in Kordofan Region, Sudan

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Abstract

The present work was conducted in the Laboratory of Biochemistry and Food science department; University of Kordofan, Sudan. The objective of this study was to investigate the effect of storage period on quality parameters of Brand edible oils. Five samples of Brand edible oils (Tyeb, Zahbia, Cotton/Groundnut mixture, Cotton, Sesame/groundnut and Traditional Sesame oil) were collected from Elobeid town Supermarket in Kordofan State. The oil samples were stored at ambient temperature (370 ± 40 C) for intervals of 0,2,4,6,8,10 and 12 months. Oils samples of were withdrawn after each storage period for monitoring changes in quality parameters, which include Acid value, FFA %, peroxide values, Anisidine values, Totox values and polymer content. Data generated was analyzed using Statistical Package for Social Sciences (SPSS). Means (± SD) were tested using one factor analysis of variance (ANOVA) and then separated using Duncan's Multiple Range (DMRT) [1]. Traditional Sesame oil reported a distinguished performance with respect to acid value. It can be conclude that and refer to Acid value, Tyeb oil can be stored from 0 time up to 12 month, so, it is the most stable oil, Cotton oil storage period must be extended from 0 time to 6 months and also it can be regarded as moderate stable oil, Traditional Sesame oil can be stored up to 12 months, so, it is a stable oil as the case of Tyeb oil. Sesame with Groundnut oil and Cotton with Groundnut oil demonstrated poor storage performance with regard to acid value because all values found to be above the permissible level even at 0 times (sooner after product). It can be concluded that and refer to fatty Acid content Tyeb oil can be stored from up to 12 month, so, it is the most stable oil, Cotton oil storage period must be used sooner after production if fatty acid content is as a critical undesired aspect in oil consumption, Traditional Sesame oil can be stored up to 12 months, so, it is a stable oil as the case of Tyeb oil. Sesame with Groundnut oil and Cotton with Groundnut oil demonstrated inferior storage performance with regard to fatty acid value because all values found to be above the permissible level even at 0 times (sooner after production). It can be deduced that as oil Peroxide value increased the oil will has a tendency to react and release more Ketones and Aldehides, consequently, Anisidine value increased which was indicated by Cotton oil. It can be deduced that as oil Anisidine value increased Totox as shown in case of Cotton oil.

Keywords: Storage Period; Quality Parameters; Brand Oils; Oil Standards

Introduction

Lipids and triacylglycerol naturally occur in oils and fats. Their chemical composition contains saturated and unsaturated fatty acids and glycerides. Edible oils are vital constituents of our daily diet, which provide energy, essential fatty acids and serve as a carrier of fat soluble vitamins. Mustard oil contains a high amount of monounsaturated fatty acids and a good ratio of polyunsaturated fatty acids, which is good for the heart. Different physical and chemical parameters of edible oil were used to monitor the compositional quality of oils [2,3]. These physicochemical parameters include iodine value (IV), saponification value (SV), viscosity, density and peroxide value (PV). Edible oils are one of the main constituents of the diet used for cooking purposes. Several researchers studied the impact of temperature on the stability, viscosity, peroxide value, and iodine value to assess the quality and functionality of the oil [4-6]. Repeated frying causes several oxidative and thermal reactions which results in change in the physicochemical, nutritional and sensory properties of the oil [7]. During storing, due to hydrolysis, oxidation and polymerization processes the composition of oil changes which in turn changes the flavor and stability of its compounds [8]. During Unconditional storing different reactions depend on some factors such as replenishment of fresh oil, Atmospheric condition, original quality of type oil and decrease in their oxidative stability [9]. Atmospheric oxygen reacts instantly with lipid and other organic compounds of the oil to cause structural degradation in the oil which leads to loss of quality of food and is harmful to human health [10]. Therefore, it is essential to monitor the quality of oil to avoid the use of abused oil due to the health consequences of consuming foods fried in degraded oil [11]. Lipid peroxidation is a major deteriorative change commonly encountered in oil and the extent of lipid peroxidation depends on different factors which include the fatty acid composition viz-a-viz level of unsaturation; packaging material and storage condition [12]. These factors are known to accelerate lipid peroxidation and the development of rancidity in oil. Glass, metals and different kinds of plastic bottles have been used to package oil, each with its advantages and limitations.

Materials and Methods

Samples of Vegetable oils

Vegetable oils were collected from Elobeid Supermarket in North Kordofan State.

Ten different of edible oils commonly used in Sudan, namely, Tyeb, Zahbia, Cotton/Groundnut mixture, Cotton, Sesame/groundnut and Traditional Sesame oil.

Chemicals and reagents

All chemicals and reagents used were of analytical grade (BDH), obtained from the Sudanese Standard and Metrology Organization (SSMO) and laboratory of the Department of Food Science and technology, College of Natural Resource and Environmental Studies University of Kordofan.

Storage conditions

Oil samples stored at ambient temperature (37^0 C ± 4^0) for intervals of 0,2,4,6,8,10 and 12 months. Samples of oils were withdrawn after each storage period for monitoring changes in chemical properties.

Chemical changes in quality parameters of oil during storage period

Acid value (AV mg KOH /g oil)

Acid value was determined according to [13].

Free fatty acids (FFA %)

Free fatty acids (FFA) was deter minted according to [14] Cock and Van Rede (1966).

Peroxide value (PV Meq H2O2/ Kg oil)

Peroxide value (PV) of oils, which indicates the extent of overall oxidation, was determined according to the [15] method.

Anisidine value (AV MeqO2/Kg oil)

The Anisidine value (A.V) or the carbonyl value was measured in the oil according [16] Test Methods.

Totox Value (TV MeqO2/Kg oil)

The Totox Value is calculated value based on peroxide and Anisidine value was determined according to the Equation of [16].

Totox Value = 2×proxide + Anisidine value

Polymer content (PC %)

Polymer content (PC) was determined according to [17].

Statistical analysis

Data generated was analyzed using Statistical Package for Social Sciences (SPSS). Means (± SD) were tested using one factor analysis of variance (ANOVA) and then separated using Duncan's Multiple Range (DMRT) according to [1].

Results and Discussion

Effect of storage period on acid value of brand oils samples in comparing with sudanese standards

Table 1 showed that In case of Tyeb oil, Acid value during each storage period found to be lower than permissible value by 0.240 mg KOH/g, 0.210 mg KOH/g, 0.190 mg KOH/g, 0.120 mg KOH/g, 0.087 mg KOH/g, 0.040 mg KOH/g and 0.017 mg KOH/g at 0 time and storage period of 2 months, 4 months, 6 months, 8 months, 10 months and 12 months respectively. The results showed that the acid value increases with period of storage but it is maintained below the permissible value.

Regarding Zahbia oil, Acid value at 0 time and during storage periods of 2 months, 4 months and 6 months found to be lower than permissible value by 0.233 mg KOH/g, 0.200 mg KOH/g, 0.160 mg KOH/g, 0.083 mg KOH/g respectively while during the periods 8 months, 10 months and 12 months, the acid value was higher than the permissible value by 0.023 mg KOH/g, 0.097 mg KOH/g and 0.130 mg KOH/g respectively. It was indicated that as period of storage increased the acid value increased to reach a value above the permissible limit.

In case of Cotton with Groundnut oil, All storage periods recorded higher acid values as compared with the permissible value by 0.553 mg KOH/g, 0.597 mg KOH/g, 1.123 mg KOH/g, 1.40 mg KOH/g, 1.560 mg KOH/g, 2.397 mg KOH/g and 2.550 mg KOH/g.

With respect to Cotton oil, the acid value was lower than the permissible value by 0.220 mg KOH/g, 0.140 mg KOH/g, 0.130 mg KOH/g, 0.010 mg KOH/g at 0 time, 2 months, 4 months and 6 months respectively while the value was higher than the permissible value by 0.020 mg KOH/g, 0.117 mg KOH/g and 0.400 mg KOH/g at 8 months, 10 months and 12 months. The acid values for such oil reported by Othman 1996 at 0 time and 6 months storage period were 0.50 mg KOH/g and 0.51 mg KOH/g respectively while the acid values reported in the present study for the same periods were 0.380 mg KOH/g and 0.590 mg KOH/g, therefore, there were no significant differences between the values indicated by Othman and these indicated in the study. It can be indicated that Cotton oil is the most stable oil and it is not affected severely by storage period in term of acid value, and it was indicated that 6 month storage period can be considered as a maximum period for storing the oil.

For Sesame with Groundnut oil, Ten months storage period recorded significant differences as compared with other periods except 10 months period at 0.05 levels, also at 4 months period the differences in acid value were significant at 0.05 levels as compared with rest periods. Acid values in case of this oil were found to be higher than permissible limit by 0.177 mg KOH/g, 0.660 mg KOH/g, 1.597 mg KOH/g, 3.080 mg KOH/g, 3.703 mg KOH/g, 4.493 mg KOH/g and 4.570 mg KOH/g at 0 time, 2 months, 4 months, 6 months, 8 months, 10 months and 12 months respectively. Othman 1996 recorded 2.12 mg KOH/g and 2.43 mg KOH/g higher than permissible limit at 0 time and 6 months storage period respectively, so, the acid values recorded in the present study were less than Othman value at 0 time and higher at 6 months.

In case of Sesame Traditional oil, All storage periods showed lower acid values as compared with the permissible level by 0.233 mg KOH/g, 0.177 mg KOH/g, 0.160 mg KOH/g, 0.100 mg KOH/g,

0,087 mg KOH/g, 0.013 and 0.007 mg KOH/g, respectively. It can be deduced that the acid value increased with storage periods but it was kept below the permissible limit, therefore, Sesame Traditional oil reported a distinguished performance with respect to acid value.

Type of oil	Storage periods of brand oil per months						
	0day	2 month	4 month	6 month	8 month	10 month	12 month
Tyeb	(0.360) D ± 0.06	(0.390) CD ± 0.00	(0.410) CD ± 1.00	(0.480) BC ± 0.07	(0.513) AB ± 0.02	(0.560) AB ± 0.03	(0.583) A ± 0.02
Zahbia	(0.367) D ± 0.03	(0.400) D ± 1.00	(0.440) CD ± 0.07	(0.517) C ± 0.01	(0.623) B ± 0.01	(0.697) AB ± 0.05	(0.730) A ± 0.02
Cotton and Groundnut	(1.153) C ± 0.16	(1.197) C ± 0.23	(1.723) BC ± 0.19	(2.000) B ± 0.00	(2.160) B ± 0.03	(2.997) A ± 0.46	(3.150) A ± 0.243
Cotton	(0.380) C ± 0.31	(0.460) BC ± 0.04	(0.470) BC ± 0.16	(0.590) B ± 0.00	(0.620) B ± 0.09	(0.717) B ± 0.09	(1.000) A ± 0.37
Sesame and Groundnut	(0.777) E ± 0.13	(1.260) E ± 0.24	(2.197) D ± 0.34	(3.680) C ± 0.45	(4.303) BC ± 0.46	(5.093) AB ± 0.09	(5.170) A ± 0.00
Sesame Traditional	(0.367) C ± 0.06	(0.423) BC ± 0.06	(0.440) BC ± 0.04	(0.500) AB ± 0.01	(0.513) AB ± 0.01	(0.587) A ± 0.01	(0.593) A ± 0.04
Permissible Value	0.6 mg KOH/gram oil according to SSMO [18].						

Table 1: Effect of storage period on Brand oils Acid value.

*Value in rows share the same superscript letter show no significant different at 0.05 level.

Effect of storage period on Brand oils Free Fatty acid value

Table 2 demonstrated that in case to Tyeb oil Throughout the storage periods the fatty acid percentages were lower than the permissible percentage by 0.120%, 0.110%, 0.100%, 0.060%, 0.043%, 0.020% and 0.007% at 0 time, 2 months, 4 months, 6 months, 8 months, 10 months and 12 months respectively. It was concluded that the fatty acid percentage increased with increase of storage period but the values were kept below the permissible limit.

Referring to the Zahbia oil. The fatty acid percentages were lower than the permissible percentage by 0.117%, 0.100%, 0.080%, and 0.042% at 0 time, 2 months, 4 months and 6 months while they were higher than the permissible level by 0.017%, 0.048% and 0.065% at 8 months, 10 months and 12 months storage periods respectively.

With respect to Cotton with ground oil, the fatty acid percentages were found to be higher than the permissible level by 0.277% at 0 times, 0.298% at 2 months, 0.562% at 4 months, 0.700% at 6 months, 0.780% at 8 months, 1.198% at 10 months and 1.275% at 12 months storage periods.

For Cotton oil, Fatty acid percentage at 0 time was lower than the permissible level by 0.002% while at 2 months, 4 months, 6 months, 8 months, 10 months and 12 months storage periods the percentages were higher than permissible level by 0.303%, 1.697%, 2.673%, 3.437%, 3.808% and 4.088% respectively. According to that specification that indicated the permissible fatty acid percentage as ≤ 0.225, 0 time, 2 months, 4 months, 6 months, 8 months, 10 months and 12 months the oil recorded 0.073%, 0.378%, 1.772%, 2.748, 3.512%, 3.883% and 4.163% higher than that specification,

the results obtained from the present study were disagreed with Othman 1996 results which reported that the fatty acid content of such oil at 0 time and 6 moths storage period was 0.25% and that may be due to differences in storage conditions.

In case of Sesame with Groundnut oil, The percentages of fatty acid in the oil found to be higher than the permissible level by 0.088%, 0.330%, 0.798%, 1.540%, 1.852%, 2.247%, and 2.285% at 0 time, 2 months, 4 months, 6 months, 8 months, 10 months and 12 months. The results obtained from the present work showed fatty acid percentages lower than these reported by Othman 1996 (1.376%) at 0 time and higher than Othman 1996 finding (1.52%) at 6 months storage period.

In case of Sesame Traditional, The results showed that the fatty acid percentage increased with increase of storage period to reach the maximum value at 12 months, but the levels were below the permissible limit, so, the effect of storage period on the oil was not much critical in raising the fatty acid content.

Table 2: Effect of storage period on Brand oils free fatty acid.

Type of oil	Storage periods of brand oil per months						
	0 day	2 month	4 month	6 month	8 month	10 month	12 month
Tyeb	(0.180) D ± 0.03	(0.190) CD ± 0.00	(0.200) CD ± 0.50	(0.240) BC ± 0.03	(0.257) AB ± 0.01	(0.280) AB ± 0.01	(0.293) A ± 0.01
Zahbia	(0.183) D ± 0.01	(0.200) D ± 0.50	(0.220) CD ± 0.03	(0.258) C ± 0.01	(0.317) B ± 0.01	(0.348) AB ± 0.03	(0.365) A ± 0.01
Cotton and Groundnut	(0.577) C ± 0.16	(0.598) C ± 0.23	(0.862) BC ± 0.19	(1.000) B ± 0.00	(1.080) B ± 0.01	(1.498) A ± 0.46	(1.575) A ± 0.24
Cotton	(0.298) D ± 0.04	(0.603) D ± 0.96	(1.997) C ± 0.22	(2.973) B ± 0.19	(3.737) A ± 0.58	(4.108) A ± 0.31	(4.388) A ± 0.28
Sesame and Groundnut	(0.388) E ± 0.07	(0.630) E ± 0.12	(1.098) D ± 0.17	(1.840) C ± 0.22	(2.152) BC ± 0.22	(2.547) B ± 0.04	(2.585) A ± 0.00
Sesame Traditional	(0.183) C ± 0.03	(0.213) BC ± 0.03	(0.220) BC ± 0.02	(0.250) AB ± 0.01	(0.257) AB ± 0.01	(0.293) A ± 0.01	(0.297) A ± 0.01
Permissible Value	To be ≤ 0.22 % according to SSMO [18].						

*Value in rows share the same superscript letter show no significant different at 0.05 level.

Effect of storage period on brand oils peroxide value

Table 3 presented effect of storage period on Peroxide value which its permissible value is reported to be ≤ 10 Meq/Kg oil according to SSMO [18] specification. In case of For *Tyeb* oil, Peroxide value increased with time till reach the highest value of 39.00 Meq/Kg oil at 6 months and then decreased to its lowest value of 22.30 Meq/Kg oil at 12 months, and it was found that the values were higher than permissible one by 18.0 Meq/Kg oil, 21.20 Meq/Kg oil, 23.1 Meq/Kg oil, 29.0 Meq/Kg oil, 28.2 Meq/Kg oil. 22.3 Meq/Kg oil and 12 Meq/Kg oil at 0 time, 2 months, 4 months, 6 months, 8 months, 10 months and 12 months respectively.

Regarding the *Zahbia* oil, Peroxide value was higher than the permissible level by 24.1 Meq/Kg oil, 26.6 Meq/Kg oil, 28.3 Meq/Kg oil, 27.7 Meq/Kg oil, 30.0 Meq/Kg oil, 19.8 Meq/Kg oil and 4.8 Meq/Kg oil at 0 time, 2 months, 4 months, 6 months, 8 months, 10 months and 12 months respectively.

In case of Cotton with Groundnut oil, Peroxide value was increased with storage period to reach the maximum value of 59.40 Meq/Kg oil at 12 months period and all values were higher than the permissible level by 11.1 Meq/Kg oil, 13.2 Meq/Kg oil, 17.9 Meq/

Kg oil, 23.2 Meq/Kg oil, 26.8 Meq/Kg oil, 39.8 Meq/Kg oil and 49.4 Meq/Kg oil at 0 time, 2 months, 4 months, 6 months, 8 months, 10 months and 12 months storage period.

In case of Cotton with Groundnut oil, Peroxide value was increased with storage period to reach the maximum value of 59.40 Meq/Kg oil at 12 months period and all values were higher than the permissible level by 11.1 Meq/Kg oil, 13.2 Meq/Kg oil, 17.9 Meq/Kg oil, 23.2 Meq/Kg oil, 26.8 Meq/Kg oil, 39.8 Meq/Kg oil and 49.4 Meq/Kg oil at 0 time, 2 months, 4 months, 6 months, 8 months, 10 months and 12 months storage period.

With regard to Cotton oil, Peroxide value was increased with storage period to reach the maximum value of 73.40 Meq/Kg oil at 12 months period and all values were higher than the permissible level by 37.6 Meq/Kg oil, 37.9 Meq/Kg oil, 44.0 Meq/Kg oil, 46.1 Meq/Kg oil, 46.2 Meq/Kg oil, 55.3 Meq/Kg oil and 63.4 Meq/Kg oil. The obtained results disagreed with [19] findings at 0 time where the Peroxide value was lower than permissible value, but the results were agreed with these reported by Othman at 6 months and 10 months storage periods where in both cases the Peroxide values were higher than the permissible level.

In case of Sesame with Groundnut oil, Peroxide value was increased with storage period to reach the maximum value of 23.50 Meq/Kg oil at 12 months period, at 0 time and 2 months storage period, the values were lower than the permissible level by 1.7 Meq/Kg oil and 0.4 Meq/Kg oil while at 4 months, 6 months, 8 months, 10 months and 12 months storage period, the values were higher than the permissible level by 1.8 Meq/Kg oil, 4.1 Meq/Kg oil, 5.7 Meq/Kg oil, 9.7 Meq/Kg oil and 13.5 Meq/Kg oil respectively.

With respect to Sesame Traditional oil, Peroxide value tends to increase with time to reach its highest value of 25.0 Meq/Kg oil at 8 months storage period and then decreases. Only at 0 time the value found to be lower than the permissible level, but the value at 2 months, 4 months, 6 months, 8 months, 10 months and 12 months storage period the values were higher than the permissible level by 2.9 Meq/Kg oil, 6.1 Meq/Kg oil, 8.7 Meq/Kg oil, 15.0 Meq/Kg oil and 7.9 Meq/Kg oil and 3.4 Meq/Kg oil respectively. The present results of the study disagreed with [19] findings, that Othman results reported very high Peroxide value at 6 months (74.4 Meq/Kg oil) and10 months (122.0 Meq/Kg oil) even at 0 time, [19] findings reported 10.5 Meq/Kg oil which is higher than the permissible level by 0.5 Meq/Kg oil even if it was not significant difference.

Table 3: Effect of storage period on Brand oils Peroxide value.

Type of oil	Storage periods of brand oil per months						
	0 day	2 month	4 month	6 month	8 month	10 month	12 month
Tyeb	(28.00) C ± 0.03	(31.20) BC ± 0.09	(33.10) BC ± 5.77	(39.00) A ± 0.01	(38.20) A ± 0.04	(32.30) B ± 11.98	(22.30) D ± 0.04
Zahbia	(34.10) C ± 0.10	(36.60) BC ± 0.38	(38.30) BC ± 0.02	(37.70) BC ± 0.23	(40.90) A ± 0.25	(29.80) D ± 0.20	(14.80) E ± 0.11
Cotton and Groundnut	(21.10) E ± 0.10	(23.20) E ± 0.17	(27.9) D ± 0.04	(33.20) C ± 0.86	(36.80) C ± 0.11	(49.80) B ± 0.03	(59.40) A ± 0.02
Cotton	(47.60) D ± 0.11	(47.90) D ± 0.10	(54.00) C ± 0.09	(56.10) C ± 0.04	(56.20) C ± 0.17	(65.30) B ± 0.86	(73.40) A ± 0.11
Sesame and Groundnut	(8.30) E ± 0.04	(9.60) D ± 0.10	(11.80) D ± 0.05	(14.10) C ± 0.10	(15.70) C ± 0.02	(19.70) BC ± 0.02	(23.50) A ± 0.10
Sesame Traditional	(5.90) D ± 0.17	(12.9) C ± 0.02	(16.10) BC ± 0.42	(18.7) BC ± 0.12	(25.00) A ± 0.36	(17.90) BC ± 0.08	(13.40) C ± 0.02
Permissible Value	To be ≤ 10 Meq/Kg according to according to SSMO [18].						

Value in rows share the same superscript letter show no significant different at 0.05 level.

Effect of storage period on Brand oils Anisidine value

Table 4 presented effect of storage period on Anisidine value which its permissible value is reported to be ≤ 26 Meq/Kg according to Sudanese specification [18]. In case of For Tyeb oil, Anisidine value increased with time till reach the highest value of 20.33 Meq/Kg oil at 6 months and then decreased to value of 16.00 Meq/Kg oil at 12 months, and it was found that the values were lower than permissible one by 11.67 Meq/Kg oil, 9.67Meq/Kg oil, 8.33 Meq/Kg oil, 5.67 Meq/Kg oil, 6.00 Meq/Kg oil. 7.67 Meq/Kg oil and 10.00 Meq/Kg oil at 0 time, 2 months, 4 months, 6 months, 8 months, 10 months and 12 months respectively.

Regarding the Zahbia oil, Anisidine value in the oil reached its highest value of 20.00 Meq/Kg oil at 8 months while the lowest value of 10 Meq/Kg oil was recorded at 12 months storage period. The value was lower than permissible level throughout storage period by 9.0 Meq/Kg oil, 8.0 Meq/Kg oil, 6.33 Meq/Kg oil, 6.67 Meq/Kg oil, 6.0 Meq/Kg oil, 11.33 Meq/Kg oil and 16.0 Meq/Kg oil at all months respectively.

In case of Cotton with Groundnut oil, Anisidine value was increased with storage period to reach the maximum value of 38.00 Meq/Kg oil at 12 months period. At 0 time, 2 months, 4 months, 6 months and 8 months, Anisidine values were lower than the permissible level by 13.33 Meq/Kg oil, 12.67 Meq/Kg oil, 9.00 Meq/Kg oil, 7.67 Meq/Kg oil, 5.00 Meq/Kg oil respectively while at 10 months and 12 months, the values were higher than the permissible level by 3.00 Meq/Kg oil and 12.00 Meq/Kg oil respectively. It can be concluded that shorter periods from 2 months to 8 months were considered as optimum periods for storing the oil.

With regard to Cotton oil, Anisidine value was increased with storage period to reach the maximum value of 38.00 Meq/Kg oil at 12 months period and all values were higher than the permissible level by 2.0 Meq/Kg oil at 0 time, 2.0 Meq/Kg oil at 2 months, 3.0 Meq/Kg oil at 4 months, 3.33 Meq/Kg oil at 6 months, 3.33 Meq/Kg oil at 8 months, 5.67 Meq/Kg oil at 10 months, and 12.0 Meq/Kg oil at 12 months.

In case of Sesame with Groundnut oil, Anisidine value was increased with storage period to reach the maximum value of 12.33 Meq/Kg oil at 12 months but all values throughout storage periods were lower than the permissible level by 22.1 Meq/Kg oil, 21.67 Meq/Kg oil, 18.67 Meq/Kg oil, 18.33 Meq/Kg oil, 18.0 Meq/Kg oil, 15.0 Meq/Kg oil and 13.67 Meq/Kg oil at all months respectively. It was concluded that the oil characterized by low Anisidine values and has an ability to keep the value below the permissible level during all storage periods.

With respect to Sesame Traditional oil, Anisidine value tends to increase with time to reach its highest value of 19.00 Meq/Kg oil at 8 months storage period and then decreases. the values found to be lower than the permissible level by 23.00 Meq/Kg oil, 16 Meq/Kg oil, 12 Meq/Kg oil, 10.67 Meq/Kg oil, 7.00 Meq/Kg oil, 10.00 Meq/Kg oil and 11.00 Meq/Kg oil at all months of storage periods respectively.

Table 4: Effect of storage period on Brand oils Anisidine value.

Type of oil	Storage periods of brand oil per months						
	0 day	2 month	4 month	6 month	8 month	10 month	12 month
Tyeb	(14.33) D ± 2.82	(16.33) BCD ± 0.57	(17.67) ABCD ± 1.15	(20.33) A ± 1.58	(20.00) AB ± 1.00	(18.33) ABC ± 1.28	(16.00) C ± 1.00
Zahbia	(17.00) AB ± 1.00	(18.00) AB ± 1.00	(19.67) A ± 0.57	(19.330) A ± 1.55	(20.00) A ± 2.00	(14.67) B ± 3.05	(10.00) C ± 1.00
Cotton and Groundnut	(12.67) E ± 2.08	(13.33) E ± 1.16	(17.00) D ± 1.00	(18.33) CD ± 0.77	(21.00) C ± 1.00	(29.00) B ± 1.00	(38.00) A ± 1.00
Cotton	(28.00) BC ± 1.00	(28.00) C ± 2.00	(29.00) BC ± 1.00	(29.33) C ± 1.15	(29.33) BC ± 1.15	(31.67) B ± 1.52	(38.00) A ± 1.00
Sesame and Groundnut	(3.90) B ± 5.28	(4.33) B ± 1.28	(7.33) AB ± 0.77	(7.67) AB ± 0.5	(8.00) AB ± 2.0	(11.00) A ± 1.00	(12.33) A ± 1.55
Sesame Traditional	(3.00) D ± 1.00	(10.00) C ± 2.00	(14.00) B ± 0.00	(15.33) B ± 1.55	(19.00) A ± 1.00	(16.00) AB ± 1.00	(15.00) B ± 1.00
Permissible Value	To be ≤ 26 Meq/Kg according to SSMO [18].						

*Value in rows share the same superscript letter show no significant different at 0.05 level.

Effect of storage period on Brand oils Totox value

Table (5) presented effect of storage period on Totox value which its permissible value is reported to be ≤ 30 Meq/Kg according to Sudanese specification [18]. In case of For Tyeb oil, Totox value increased with time till reach the highest value of 98.33 Meq/Kg oil at 8 months and then decreased to reach its lowest value of 60.60 Meq/Kg oil at 12 months. It was found that the values were higher than permissible level by 40.33 Meq/Kg oil, 48.737Meq/Kg oil, 53.87 Meq/Kg oil, 66.40 Meq/Kg oil, 68.33 Meq/Kg oil. 52.93 Meq/Kg oil and 30.60 Meq/Kg oil at all months respectively.

Regarding the Zahbia oil, Totox value in the oil was increased to reach its highest value of 103.80 Meq/Kg oil at 8 months and then decreased to reach its lowest value of 39.60 Meq/Kg oil at 12 months storage period. The values were higher than permissible level throughout storage period at all months respectively. It can conclude that the oil characterized by high Totox value from 0 times up to 12 months of storage.

In case of Cotton with Groundnut oil, there were the differences in Totox value recorded significant differences at 0.05 level between all storage period. Totox value was increased with storage period to reach the maximum value of 156.80 Meq/Kg oil at 12 months period. The values of Totox were higher than permissible level throughout all storage period respectively.

With regard to Cotton oil, Totox value was increased with storage period to reach the maximum value of 184.80 Meq/Kg oil at 12 months period and all values were higher than the permissible level by 93.20 Meq/Kg oil at 0 time, 93.80 Meq/Kg oil at 2 months, 107.00 Meq/Kg oil at 4 months, 111.53 Meq/Kg oil at 6 months, 111.73 Meq/Kg oil at 8 months, 132.27 Meq/Kg oil at 10 months, and 154.80 Meq/Kg oil at 12 months.

In case of Sesame with Groundnut oil, Totox value was increased with storage period to reach the maximum value of 59.33 Meq/Kg oil at 12 months. The values were found to be lower than the permissible level by 9.50 Meq/Kg oil at 0 time and 6.47 Meq/Kg oil at 2 months and higher than the permissible value by 0.93 Meq/Kg oil at 4 months, 5.87 Meq/Kg oil at 6 months, 8.40 Meq/Kg oil at 8 months, 20.40 Meq/Kg oil at 10 months and 29.33 Meq/Kg oil at 12 months.

With respect to Sesame Traditional oil, Totox value tends to increase with time to reach its highest value of 53.33 Meq/Kg oil at 8 months storage period and then decreases. the values at 0 time found to be lower than the permissible level by 15.20 Meq/Kg oil while at 2 months, 4 months, 6 months, 8 months, 10 months and 12 months, the values were higher than the permissible level by 5.00 Meq/Kg oil, 16.60 Meq/Kg oil, 22.73 Meq/Kg oil, 23.33 Meq/Kg oil, 14.13 Meq/Kg oil and 11.80 Meq/Kg oil respectively.

Table 5: Effect of storage period on Brand oils Totox value.

Type of oil	Storage periods of brand oil per months						
	0 day	2 month	4 month	6 month	8 month	10 month	12 month
Tyeb	(70.33) C ± 1.16	(78.73) BC ± 3.78	(83.87) B ± 3.78	(96.40) A ± 0.00	(98.33) A ± 0.00	(82.93) B ± 2.08	(60.60) D ± 7.50
Zahbia	(85.20) D ± 1.58	(91.20) C ± 0.57	(94.73) B ± 1.15	(96.27) B ± 3.79	(103.80) A ± 2.08	(74.27) E1.00	(39.60) F ± 1.00
Cotton and Groundnut	(54.87) G ± 1.15	(59.73) F ± 1.15	(72.80) E ± 1.17	(84.73) D ± 0.77	(94.60) C ± 1.00	(128.60) B ± 1.56	(156.80) A ± 1.15
Cotton	(123.20) E ± 2.08	(123.80) E ± 1.15	(137.00) D ± 1.15	(141.53) CD0.57	(141.73) CD1.52	(162.27) B ± 0.00	(184.80) A ± 0.00
Sesame and Groundnut	(20.50) E ± 1.52	(23.53) E ± 1.56	(30.93) D ± 2.08	(35.87) CD ± 1.52	(38.40) CD0.77	(50.40) B ± 3.79	(59.33) A ± 1.52
Sesame Traditional	(14.80) D ± 7.56	(35.80) C ± 1.58	(46.60) B ± 1.00	(52.73) A ± 2.00	(53.33) A ± 1.00	(44.13) B ± 1.16	(41.80) BC ± 2.00
Permissible value	To be ≤ 30 Meq/Kg oil according to SSMO [18].						

*Value in rows share the same superscript letter show no significant different at 0.05 level.

Effect of storage period on Polymer Content (%) of Brand oils

Table (6) presented effect of storage period on Polymer Content as%, In case of For *Tyeb* oil, Polymer content increased with storage period up to 8 months to reach its highest value of 80.66% and then decreased. It was concluded that the lowest polymer content was reported at 0 time and 2 months with values of 0.13% and 0.43%, hence, the optimum storage period for such oil must be up to 2 months to avoid excessive formation of polymer.

Regarding Zahbia oil, Polymer content increased with storage period up to 8 months to reach its highest value of 74.00% and then decreased. It was concluded that the lowest polymer content was reported at 0 time and 2 months with values of 0.16% and 0.60%, therefore, the optimum storage period for such oil must be up to 2 months to reduce formation of polymer. In case of Cotton with Groundnut oil, Polymer content increased with storage period up to 10 months and 12 months to reach its highest values of 38.67% and 38.66%. It was concluded that the lowest polymer content was reported at 0 time (0.10%), 2 months (0.27%) and 4 months (0.27%), these latter two values were approximately doubled at 6 months and 8 months (0.50% and 0.53%), therefore, the optimum storage period for such oil must be up to 4 months to inhibit release of polymer. With regard to Cotton oil, Polymer content was kept constant at 0% level from 0 times to 8 month period and the recorded 29.00% at 10 months and 50.67% at 12 months. In case of Sesame with Groundnut oil, Polymer content was increased from 0.10% at 4 months to reach its highest value of 33.67% at 12 months. At 0 time and 2 months storage period the polymer content was 0%, from 4 months up to 8 months the content was found to be below 0.5%. With respect to Sesame traditional oil, Polymer content at 0 time and 2 months recorded 0% and kept constant at 0.03% from 4 months up 8 months and then increased significantly to reach the highest value of 34.33% at 12 months. Up to 8 months storage period, polymer value considered tiny (0.03%). According to demonstrated results, it can be concluded that Sesame traditional oil is stable as referred to effect of storage period on polymer formation, consequently.

Table 6: Effect of storage period on Polymer Content (%) of Brand oils.

Type of oil	Storage periods of brand oil per months						
	0 day	2 month	4 month	6 month	8 month	10 month	12 month
Tyeb	(0.13) E ± 0.02	(0.43) E ± 0.07	(14.66) D ± 1.5	(53.00) C ± 1.00	(80.66) A ± 1.1	(79.00) A ± 1.00	(64.00) B ± 1.00
Zahbia	(0.16) F ± 0.01	(0.60) F ± 0.10	(11.67) E ± 1.5	(38.33) D ± 1.52	(74.00) A ± 1.0	(68.67) B ± 1.52	(56.00) C ± 1.00
Cotton and Groundnut	(0.10) B ± 0.00	(0.27) B ± 0.05	(0.27) B ± 0.07	(0.50) B ± 0.10	(0.53) B ± 0.07	(38.67) A ± 1.15	(38.66) A ± 1.52
Cotton	(0.00) C ± 0.00	(0.00) C ± 0.00	(0.00) C ± 0.00	(0.00) C ± 0.00	(0.00) C ± 0.00	(29.00) B ± 1.00	(50.67) A ± 1.17
Sesame and Groundnut	(0.00) C ± 0.00	(0.00) C ± 0.00	(0.10) C ± 0.00	(0.23) C ± 0.11	(0.40) C ± 0.00	(30.00) B ± 1.00	(33.67) A ± 1.15
Sesame Traditional	(0.00) C ± 0.00	(0.00) C ± 0.00	(0.03) C ± 5.77	(0.03) C ± 0.00	(0.03) C ± 0.05	(19.00) B ± 1.00	(34.33) A ± 0.57

*Value in rows share the same superscript letter show no significant different at 0.05 level.

Conclusion and Recommendations

Conclusion

Acid value and free fatty acid content increased as the storage period increased.

Abrar and Sabah oil recorded highest acid values above the permissible level.

Tyeb was the only oil showed the lowest acid values below the permissible level. As acid value and free fatty acid content increased, Peroxide value, Anisidine value and Totox value increased for most oils.

Peroxide, Anisidine, Totox and polymer values were fluctuating throughout storage periods, the highest values of Peroxide, Anisidine values, Totox and polymer contents was demonstrated by Cotton and Cotton with Groundnut.

Recommendations

All the Brand oil samples were collected from Elobeid Supermarket became unconformity under this storage condition due to the quality parameters of oils like Peroxide, Anisidine and Totox is highest the permissible values.

The polymer content of Brand oil needs to detect the specification limit from SSMO.

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