

Effects of Different Storage Temperature on the Physicochemical Properties of Cooking Oils Available in Nigeria Markets

AKIN-OSANAIYE Catherine Bukola¹, *GABRIEL Adeyemi Francis², ALAJE Patience² and OMONIYI Ahmed Olalekan²

¹ Department of Biological Science, Faculty of Science University of Abuja, Nigeria.

² Department of Chemistry, Faculty of Science University of Abuja, Nigeria.

*Corresponding Author

Tel: +2347083004222

E-mail: yemigabriel@yahoo.com

Abstract: The assessment of vegetable oil in terms of stability is important for the determination of its shelf life as oil is expected to be of high quality during storage and up to the time of consumption and for other usage. In this study, physicochemical properties of oils were determined every two weeks interval by standard method of AOCS. The results obtained from this work showed that as time increased from week 0 to 6 weeks, the Acidity and Peroxide value, Saponification values increased while iodine values decreased in all the oils studied. The samples stored on the shelf exhibited the highest Acid values, Peroxide values, Saponification values throughout the period of storage followed by those stored inside the cupboard, the lowest Iodine values recorded were for those stored on the shelf. Based on the Acid value, Peroxide values and Iodine values, the samples stored in the refrigerator provided the best protection to the oil.

Key words: Physicochemical property, Cooking oil, Storage method, Temperature.

1. Introduction

Vegetable oils are triglycerides of fatty acids extracted from plants. It can be defined as referring only to substances that are liquid at room temperature [1] or broadly defined without regard to the substance's state of matter at a given temperature [2].

Vegetable oils are important in human nutrition as they provide energy, essential fatty acids and facilitate the absorption of fat-soluble vitamins [3]. Oil quality and its stability are therefore very important for the consumer's desirable use usually as cooking ingredient [4]. The quality

of any oil is indicated by some physicochemical properties which provide an indication of both the nutritive and physical quality of the oil. These properties include iodine value, peroxide value, saponification value, free fatty acid, colour appearance etc.

To retain oil quality, care must be taken when storing vegetable oils for a period of time to prevent their deformation as they easily undergo oxidative deterioration, hence shortening their shelf-life.

This work has been set to determine the effect of different storage method with regards to variation in temperature on the stability of vegetable oil commonly consumed by the populace in Abuja metropolis, FCT, Nigeria.

2. Experimental

Six vegetable oil samples namely: Turkey vegetable oil, Gino vegetable oil, Groundnut oil, Palm oil, Animals fat oil and Animals breast milk oil, were randomly obtained from Gwagwalada Market and Kasuwa-dere Market in Gwagwalada, Abuja, Nigeria. The samples were collected using cleaned and dried half a liter containers and were divided each into three (3) portions. Each portion was stored in a cupboard, shelf or a refrigerator for the period of six weeks.

The iodine value, acid number value, peroxide value and saponification value were determined at two weeks interval by standard method of AOCS [5]. Odour, taste and colour were also observed before every analysis.

2.1 Animal Fat Oil Extraction

Oil from cow was extracted by putting its fat into a 500 ml beaker and then boiled with water and stirred for about two (2) hours until the oil separated and was then collected.

3. Result and Discussion

The physical observations of the oils showed that they had pleasant odour and taste. At the end of the storage period (Table 1), the groundnut oil had some particles, the animal fat oil and animal breast milk oil had a change of smell while no changes were observed in the other oil samples. The vegetable oil samples were all clear golden yellow except palm oil which was red in appearance before and after storing for six weeks, Animal fat oil and animal breast milk oil in shelf and cupboard was affected by fungi, Part of animal fat changes to a blackish colour while part of animal breast milk oil changes from golden to a reddish colour by the side.

Table 1: Physical properties of vegetable oils before and after storage

Physical Properties	Turkey oil	Groundnut oil	Gino oil	Palm oil	Animal fat oil	Animal breast milk oil
Colour	Golden yellow	Golden yellow	Golden yellow	Red	Changes from Yellow to blackish	Changes from Yellow to reddish
Odour	No change	No change	No change	No change	Changes	Changes
Taste	No change	No change	No change	No change	Changes	Changes

All the selected oils have their analysed chemical properties before storage shown on table 2. They were all below the

recommended codex standard except groundnut oil and animal fat oil that were within the recommended level

Table 2: Chemical properties of vegetable oils before storage

Properties	Turkey oil	Groundnut oil	Gino oil	Palm oil	Animal fat oil	Animal breast milk oil	RCS
Iodine value	64.50 ± 0.20	84.40 ± 0.20	64.40 ± 0.30	53.30 ± 0.28	80.30 ± 0.20	60.30 ± 0.40	75-94
Acid value	0.70 ± 0.07	1.18 ± 0.23	0.56 ± 0.05	38.50 ± 0.14	1.13 ± 0.04	5.79 ± 0.07	0.60
Peroxide value	10.66 ± 0.70	10.18 ± 0.30	2.85 ± 0.04	10.68 ± 1.00	4.38 ± 0.20	8.68 ± 1.10	10max
Saponification value	120.61 ± 0.40	109.40 ± 0.20	119.20 ± 0.20	195.64 ± 0.40	139.55 ± 0.40	122.72 ± 0.35	184-196

RCS= RECOMMENDED CODEX STANDARD [6]

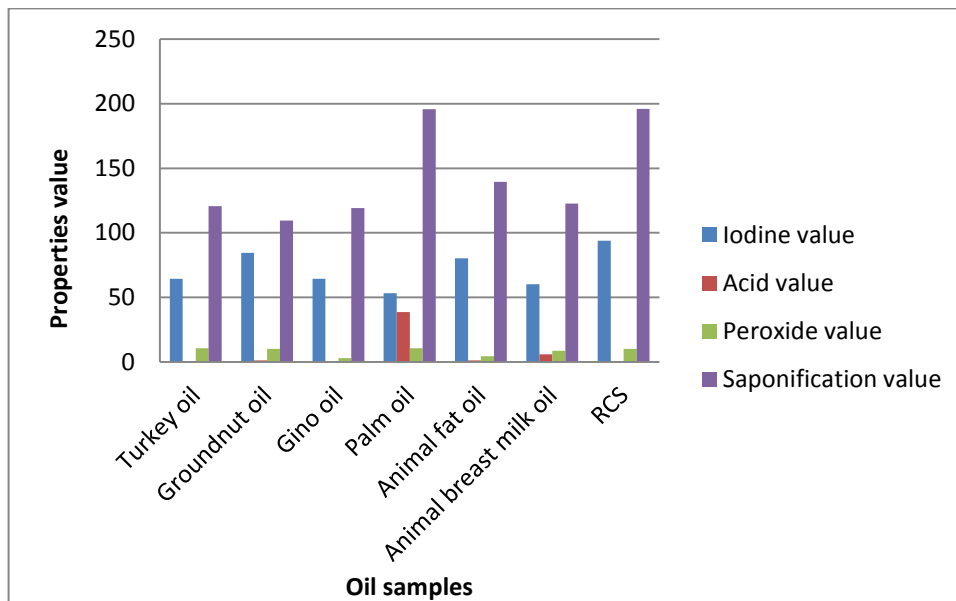


Figure 1: Chemical properties of vegetable oils before storage

It was observed that iodine value decreases gradually during storage period (Table 3). Iodine

value for all the oil samples stored in refrigerator after six weeks are higher than iodine value of oil samples stored on

Table 3: Effect of different storage type and period on the Iodine value of the vegetable oils

Storage method	shelf			Cupboard			refrigerator		
	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks
Turkey oil	52.03±0.20	51.39±0.10	49.50±0.10	63.29±0.30	52.03±0.20	50.20±0.50	63.2±0.40	53.62±0.10	52.03±0.20
Groundnut oil	65.35±0.36	62.28±0.35	56.50±0.40	68.65±0.26	62.90±0.15	60.30±0.10	78.75±0.45	69.80±0.25	61.50±0.50
Gino oil	57.74±0.30	55.30±0.20	51.39±0.30	62.49±0.20	57.55±0.18	56.74±0.15	65.40±0.15	58.69±0.50	57.43±0.50
Palm oil	67.90±0.07	59.70±0.25	47.50±0.30	51.40±0.13	45.70±0.10	42.51±0.15	53.30±0.10	51.39±0.20	50.20±0.20
Animal fat oil	47.90±0.50	42.52±0.40	36.20±0.13	65.90±0.40	57.80±0.20	45.70±0.50	71.70±0.15	70.50±0.30	69.20±0.20
Animal breast milk oil	41.55±0.20	39.92±0.42	34.90±0.30	43.20±0.20	41.90±0.35	36.20±0.20	59.65±0.45	55.30±0.25	53.29±0.50

shelf or cupboard. The decrease in iodine value may be as a result of unsaturation as the triglyceride π -bonds become oxidized below ambient temperature. Among all the oil samples, ground nut oil and animal fat has the highest initial iodine value and as expressed, unsaturated fatty acids declined during storage period, palm oil samples stored in refrigerator due to self anti oxidation capability to iodine

value did not change like those of the other oil exposed to air (shelf) and those in dark (cupboard). Gino oil has slight changes compared to the other oils in both storage places which indicate that Gino oil is more stable than the other oils and its quality remained unchanged [7]. However, the iodine value of the oils could be classified as non-drying oil, since their iodine values are less than 100 [8].

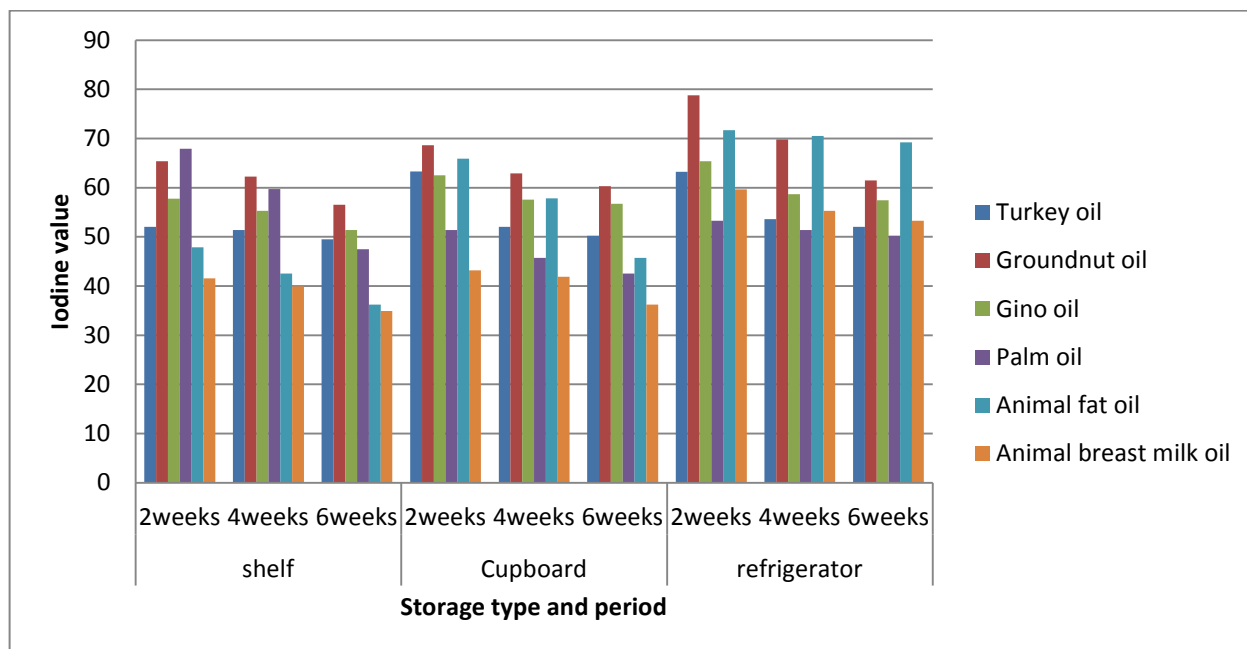


Figure 2: Showing the effect of different storage type and period on the Iodine value of the vegetable oils

Peroxide value of the selected vegetable oils at the initial peroxide values are as shown in table 2. After storage (Table 4), the peroxide values are lowest in Gino oil stored on the shelf obtained as 2.85 after the second week of storage to 5.80 after six weeks of storage. This shows that there is low amount of hydro peroxide which indicated an intermediate in rancidity or autoxidation in all Gino oils stored in the three different places. Animal fat oil also has a low amount of hydro peroxide followed by turkey oil. However there is increase in all the oils with time of storage for six weeks.

In all the selected oils, palm oil samples has the highest peroxide values in comparison to other oil samples, palm oil has the highest increase in peroxide value. At the end of the six weeks storage period as expected, oil samples stored at room temperature has higher peroxide values than the samples kept in the refrigerator because of the negative effect of temperature to oxidation of oil. Peroxide are the primary oxidation product and peroxide concentration may fluctuate over time since peroxide turn to other oxidation product with time [9].

Table 4: Effect of different storage type and period on the Peroxide Value of the vegetable oils

Storage method	shelf			Cupboard			Refrigerator		
	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks
Turkey oil	12.50±0.03	14.70±0.14	15.80±0.28	12.33±0.12	13.90±0.47	14.40±0.04	11.50±0.07	12.40±0.07	12.90±0.14
Groundnut oil	13.20±0.28	13.90±0.25	15.30±0.20	12.50±0.50	13.20±0.12	14.74±0.53	11.40±0.32	12.70±0.42	13.20±0.20
Gino oil	4.17±0.11	5.30±0.35	5.80±0.35	3.50±0.04	4.80±0.07	5.00±0.20	3.30±0.04	3.90±0.14	4.50±0.11
Palm oil	14.70±0.21	16.80±0.14	17.70±0.11	13.06±0.25	15.50±0.07	16.70±0.21	12.86±0.18	14.40±0.11	15.20±0.20
Animal fat oil	6.20±0.070	7.20±0.21	12.70±0.25	5.50±0.20	6.90±0.14	11.80±0.50	4.90±0.07	5.80±0.21	6.60±0.25
Animal breast milk oil	12.26±0.20	13.00±0.21	16.30±0.11	11.60±0.47	12.70	15.90±0.14	10.82±0.92	11.60±0.92	12.00±0.11

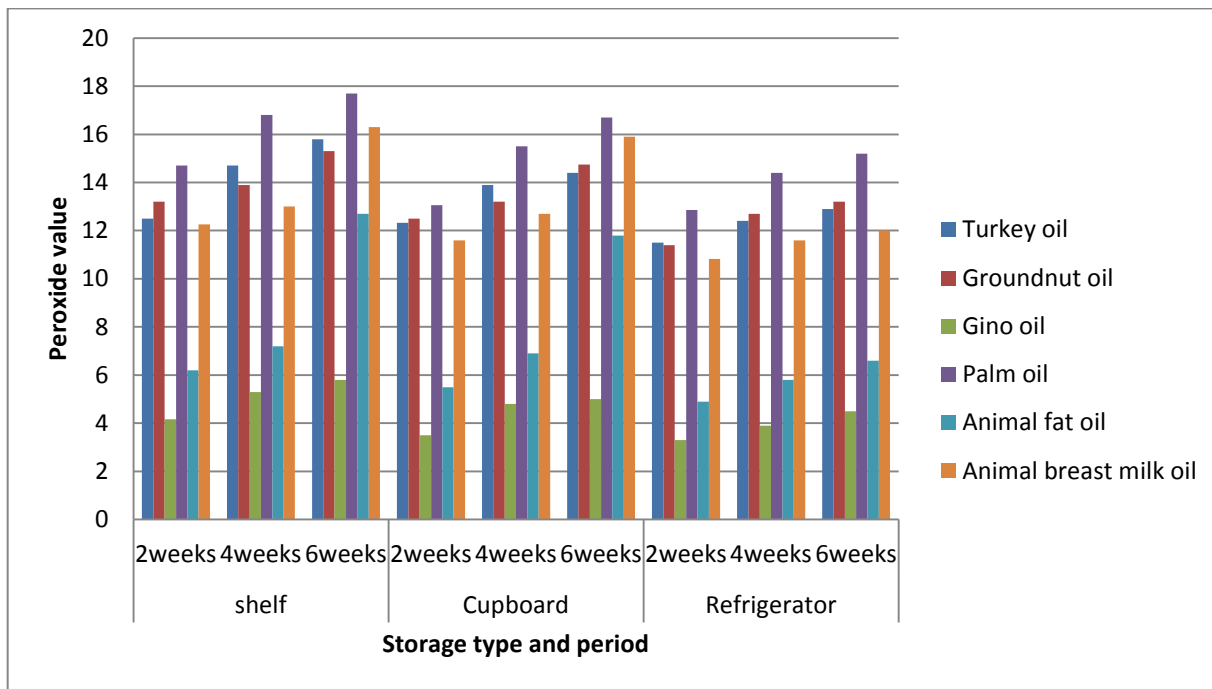


Figure 3: Effect of different storage type and period on the Peroxide Value of the vegetable oils

It was observed that there was a sharp increase in acid value for animal breast milk oil, palm oil and animal fat (Table 5). Fatty acid composition of edible oil does not follow a standard pattern because this composition is modified by the amount of saturated, mono unsaturated and poly unsaturated fatty acids. The influence of high fat intake on cardiovascular status depends on the fatty acid profile. Gino

oil has the lowest acid value followed by turkey oil from the initial time to final storage period which showed that Gino oil and turkey oil has long shelf life more than other oils studied and does not become rancid readily because the lower the acid value of oil, the fewer the fatty acid it contains which makes it less exposed to the phenomenon of rancidity [10].

Table 5: Effect of different storage type and period on the Acid value of the vegetable oils

Storage method	shelf			Cupboard			refrigerator		
Samples	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks
Turkey oil	0.98±0.07	2.58±0.30	3.37±0.07	0.85±0.07	1.77±0.13	2.50±0.21	0.85±0.14	1.48±0.15	2.22±0.19
Groundnut oil	3.40±0.11	4.02±0.10	5.04±0.11	2.90±0.35	3.62±0.29	3.59±0.18	2.25±0.18	3.52±0.30	4.30±0.11
Gino oil	1.50±0.14	2.35±0.10	3.20±0.13	1.27±0.07	2.25±0.07	2.80±0.21	1.13±0.14	1.97±0.10	2.42±0.21
Palm oil	64.30±0.32	88.07±0.04	111.40±0.40	62.50±0.71	80.50±0.04	100.50±0.32	47.50±0.89	55.2±0.35	62.28±0.30
Animal fat oil	15.29±1.89	21.90±0.35	31.70±0.30	14.03±0.07	20.19±0.08	30.30±0.14	2.40±0.035	3.90±0.28	6.40±0.30
Animal breast milk oil	54.27±0.35	73.50±0.30	106.40±0.11	36.50±0.85	63.90±0.36	94.30±0.11	28.70±0.50	52.80±0.21	76.30±0.30

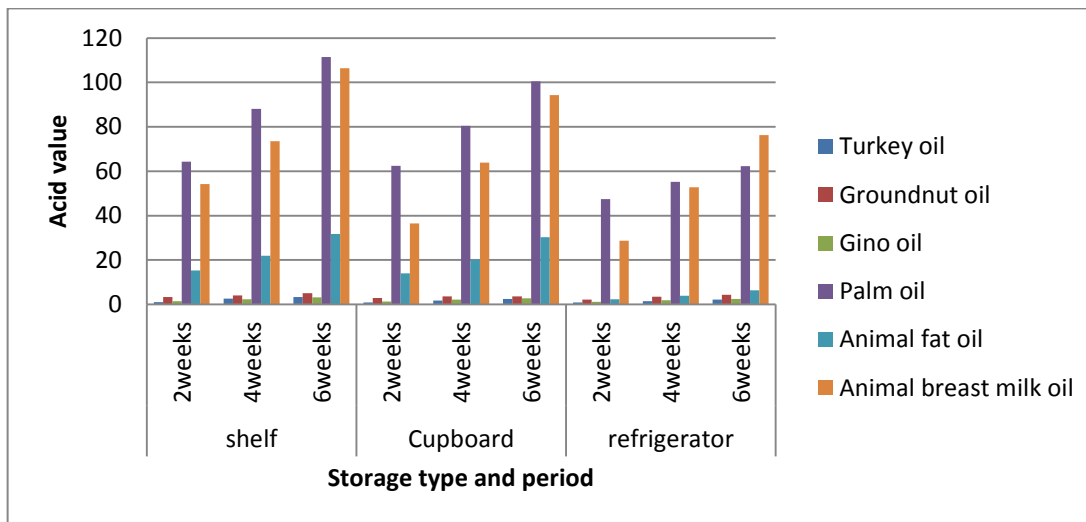


Figure4: Effect of different storage type and period on the Acid value of the vegetable oils

The changes in saponification value of the selected oil sample during storage are shown in table 6 and was observed that animal fat oil has the highest saponification value for oil stored on the shelf (212.89 mgKOH/g) followed by palm oil stored on shelf (203.36 mgKOH/g) after six weeks. It was generally observed that the oil samples stored in the refrigerator has the lowest value compared to the oil samples stored in cupboard and shelf as such oil on shelf has an appreciable increase in saponification value with increase in storage time. This

indicates that oils to be used in industries should be best stored in open air for the manufacture of soaps and toiletry. Saponification value indicate deterioration of oil and was found to be increased with time of storage as such this trend explains that with long storage of this oil, fatty acids are likely to be formed which increases the saponification value and its indicates that long stored degraded oils can play a favourable role in producing soaps and toiletry products profitably.

Table 6: Effect of different storage type and period on the Saponification value of the vegetable oils

Storage method	shelf			Cupboard			Refrigerator		
	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks
Turkey oil	129.93 ±0.20	131.13 ±0.50	133.94 ±0.50	128.33 ±0.30	130.43 ±0.10	132.54 ±0.50	121.32 ±0.20	122.02 ±0.20	122.72±0 .30
Groundnut oil	120.62 ±0.60	130.44 ±0.87	165.50 ±0.20	118.50 ±0.76	123.42 ±0.20	138.85 ±0.40	117.82 ±0.30	120.62 ±0.10	122.02±0 .30
Gino oil	122.02 ±0.30	131.90 ±0.50	139.55 ±0.30	120.62 ±0.20	125.52 ±0.40	136.75 ±0.40	119.92 ±0.30	122.02 ±0.30	122.72±0 .20
Palm oil	199.15 ±0.10	200.56 ±0.30	203.36 ±2.97	197.75 ±0.48	199.15 ±0.10	201.96 ±0.30	196.35 ±0.13	198.45 ±0.76	200.56±0 .10
Animal fat oil	210.09 ±0.33	204.76 ±0.40	212.89 ±0.20	194.95 ±0.50	203.36 ±0.10	211.78 ±0.15	131.84 ±0.30	200.55 ±0.20	208.28±0 .61
Animal breast milk oil	151.47 ±0.14	169.70 ±0.13	173.91 ±0.30	143.00 ±0.14	164.79 ±0.25	172.52 ±0.40	127.70 ±0.35	129.03 ±0.10	131.81±0 .10

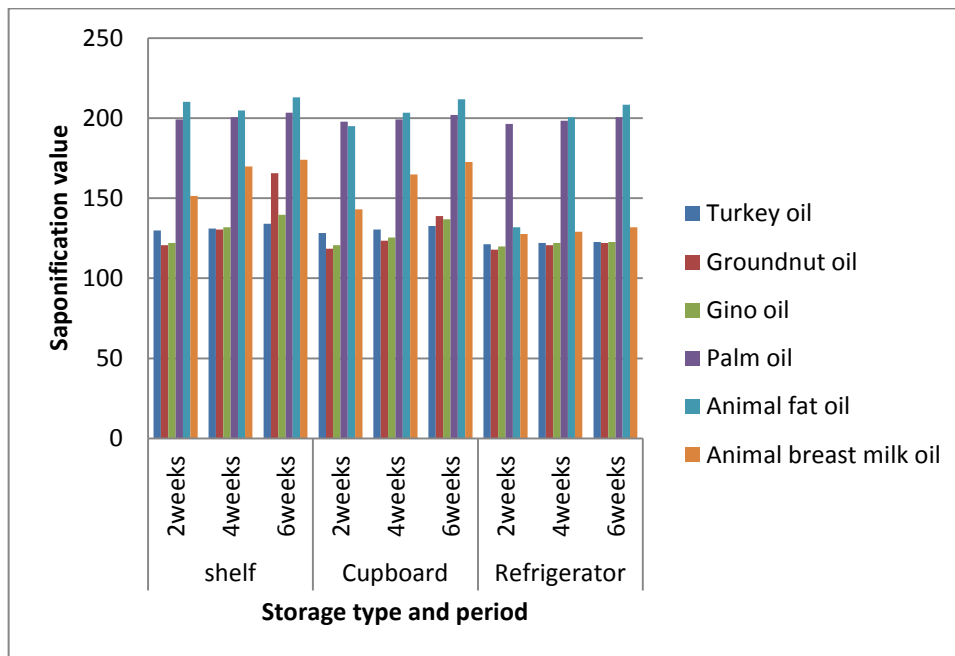


Figure 5: Effect of different storage type and period on the Saponification value of the vegetable oils

4. Conclusion and Recommendation

This study evaluated the effect of different storage time of different vegetable oils on the physicochemical properties for a period of six (6). During the storage period, changes took place in the values of quality parameters. From the results obtained it can be deduced that all the oils have similar properties in the first week except for palm oil, animal fat oil, animal breast milk oil which have much change in variation and can be well used in the production of soap and toiletry while Gino oil, turkey oil, and groundnut oil can also be used in place of the other for consumption purposes. All these vegetable oils can exist as liquid at room temperature. Oil stored in refrigerator has a

greater nutritional quality than that of cupboard and shelve upon long storage.

Recommendation drawn from this study is that oils used for cooking should be best stored in refrigerator because the acid and peroxide values obtained from such oils are lower than the other means of storage as at the research time. Gino oil and turkey oil are the most suitable vegetable oil for consumption as they maintain their quality with increase in storage time. Researches should be conducted regularly to know more necessary area of improvement in production of vegetable oils for both consumers and producers.

Conflict Of Interest

The authors declared no conflict of interest.

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