Research Article

Effect of Stress Conditions on the Quality and Stability of Olive and Palm Oil Blends

Muhammad Siddiq[1]* and Hamid Ullah Shah[2]

[1]National Tea & High Value Crops Research Institute (NTHRI), Shinkiary Mansehra, Pakistan; [2]Department of Agricultural Chemistry, The University of Agriculture, Peshawar, Khyber Pakhtunkhwa, Pakistan.

Abstract | Blending of oil has been expected as one of the most important solution in producing vegetable oil with good storage stabilities. The current study was conducted to identify the best oil blend in terms of physicochemical properties between olive and palm oils. Laboratory experiment on "Effect of stress conditions on the quality and stability of olive and palm oil blends" was conducted at Nuclear Institute for Food and Agriculture (NIFA) Tarnab Peshawar and The University of Agriculture Peshawar KP-Pakistan during 2015. Olive: palm oils treated in sole or admixture at various ratios were kept at different stress conditions for three months. Data was recorded on peroxide value (PV), free fatty acid (FFA), anisidine value (AV), iodine value (IV), color index (CI) and beta carotene (BC) value of the oils. The results showed considerable variations in all the studied parameters tested in different blends under various stress conditions. Maximum PV (10.76%), FFA (2.44%), AV (2.29), IV (77.09) and CI (0.609) were recorded in sole olive oil, while minimum PV (9.69%), FFA (0.65%), AV (0.88), IV (53.40) and CI (0.146) were noted in sole palm oil. The samples kept in sunlight showed maximum PV (12.82%), FFA (1.32%) and AV (1.39), while maximum IV (63.10), CI (0.371) and BC (11.30) value were observed in samples stored at ambient temperature. Storage conditions increased PV from 218 to 27.82, FFA from 0.88 to 1.47, AV from 1.02 to 1.56, while decreased IV from 63.38 to 58.05, CI from 0.392 to 0.337 and BC from 27.87 to 3.46. It was concluded that olive:palm oils mixed at a level of 10:90% and 20:80% ratios have the best quality stricture, which are more acceptable and better than other blends when mixed together that will achieve better strength as well as financial system phase.

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***Correspondence** | Muhammad Siddiq, National Tea & High Value Crops Research Institute (NTHRI), Shinkiary Mansehra, Pakistan; **Email:** msiddiq_k@yahoo.com
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Introduction

Edible oil is a vital food substance, source or composition that is manufactured for human consumption wholly or in part from a fat or oil other than that of milk. These are oils that have been refined, bleached and deodorized and are generally tasteless, odorless, and colourless. Pakistan is an increasing population country facing a serious shortage of edible oils for the past several years. Average consumption of oils/fats in country is 23-33 g/day (Chaudhry et al., 1998) and even with this consumption (which is lesser than the required level), fats related ailments are on the rise in our society, country spend a huge amount of money on the import of edible oils (Ali et al., 2010). Pakistan ranked fourth in the largest importers of Palm Oil and its products since long (Chaudhry et al., 1998). In Pakistan, various types of edible oils i.e., refined, bleach with deodorized (RBD) palm, sunflower, rapeseed and cotton seed oils along with hydrogenated vegetable ghee are commonly consumed by the public for cooking.

Quality and quantity are two important attributes of fats which are essentials for healthy and nutritious life. Most of the essentials components of fats including unsaturated fatty acids, vitamins, pigments, and antioxidants are sensitive to auto-photo oxidation, temperature, and radiation. The thermal, oxidation, light, hydroxylation, and radiation oxidizes and produced peroxides, hydro peroxides, and other harmful secondary metabolites including aldehydes, ketones, butyric acid and alcohols are formed, which adversely affects the fats in qualitative and nutritive values of dietary fat (Ahmad et al., 2013). The WHO recommends proportion of saturated along with monounsaturated and polyunsaturated fatty acids in the ratios of 1:1.5:1 and omega-6 with omega-3 ratio of 5:10 in the diet. But it is difficult to classify any single oil/fat as ideal. It is secure to calculate that oils by balanced chemical composition of fatty acids in their triglyceride may go by as the adjoining prototypes (Sundram et al., 2005).

Olive oil is rich in antioxidants such as vitamin E and other diverse phenolic compounds especially in extra virgin olive oil. Function of these compounds are cardio protective and anti-inflammatory (Serra et al., 2003) but oxidation of the fats reduces the organoleptic excellence of food by reducing its nutritional worth and foodstuffs of the corrosion method can contribute in the aging of a creature along with in the etiology of cardiovascular infections. Coverage of olive and palm oils to light and temperatures significantly deteriorates the quality parameters of the oils.

Palm oil has highly saturated vegetable fats which is semi-solid at room temperatures as well as contains a number of saturated and unsaturated fats in the shape of 0.1% glyceryl laurate, 1% myristate, 44% palmitate, 5% stearate as saturated, 39% oleate as monounsaturated, 10% linoleate and 0.3% alpha-linolenate as polyunsaturated fatty acids. Palm oil mostly contains saturated fatty acids which is capable of increasing blood cholesterol level (Edem, 2002).

Palm oil is an important fraction of about all nutritional fats. This oil is considered a very stable edible oil and resistant against almost all type of stress conditions. But it contains high amount of saturated fatty acids along with their unfavourable affects concerning heart associated health problems are well demonstrated. Consequently it is of great importance to investigate some native olive oils which could be used as fortificant to get better the chemical as well as nutritional quality of palm oil which sequentially could develop the incidence of fat associated diseases (Amany et al. 2013).

Palm oil is the major prospective resource of vitamin E, on behalf of mostly tocotrienols in 70% as well as tocophenols in 30%. The occurrence of usual vitamin E in palm oil makes certain a better shelf-life for palm based foodstuffs, because the vitamin E takes action against oxidation and plays a significant role in the stabilization of fats and oils (Mahsa and Mirhosseini, 2010).

Amalgamation of vegetables oils appeared as an economical way of improving the physicochemical properties of blended oil. Blend of olive and palm oils would carry benefits of both ingredients, as a commercial product for consumers. The blended oil may be able to resist changes of desirable physicochemical characteristic during stress conditions and low cost of palm oil along with nutritive benefits and consumers craving of olive oil. The present study investigate the effects of stress conditions on quality and stability of olive: palm blended oil to determine suitable storage conditions for the blended product.

Materials and Methods

A laboratory experiment was conducted on the effect of stress conditions on the quality and stability of olive and palm oil blends at Nuclear Institute for Food and Agriculture (NIFA) Tarnab, Peshawar and Department of Agricultural Chemistry, the University of Agriculture, Peshawar during 2014-15 with the objectives to identify the stability of test blends under various stress conditions. The laboratory grade reagents i.e. glacial acetic acid, chloroform, ethanol, diethyl ether and *n*-hexnae were purchased from Sigma Aldrich.

The effect of olive oil and palm oil with their four blends (10:90%, 20:80%, 40:60% & 60:40%) was assessed. The initial data was recorded for all quality attributes pre-treatment. All the oils in sole or mixture were kept at different stress conditions i.e. ambient, artificial and sunlight. The data were recorded for three months with monthly intervals. The olive oil was collected from oil extraction mill installed at Agriculture Research Institute, Tarnab. The extracted oil was stored in cleaned plastic bottles under cold dark condition. The oil was filtered using Watsman's filter

paper. Palm oil was obtained from Associated Industries Limited; Manufactures of Shama Ghee oil Products, Nowshera.

Chemical evaluation

The samples mean were initially analyzed for quality attributes i.e.

i) Peroxide Value (POV)
ii) Free fatty Acid (FFA)
iii) Anisidine value (AV)
iv) Iodine Value (IV)
v) Color Index (CI)
vi) Beta Carotene (BC)

Table 1: *Peroxide value of olive and palm oils tested in different blends at various stress conditions during three months exposure*

Condition	Blend (OO:PO)	Duration (days)				Mean
		0	30	60	90	
Ambient	100:00	3.26	3.59	6.07	20.06	8.25
	00:100	3.26	3.77	7.24	28.08	10.59
	10:90	3.26	4.61	8.60	37.26	13.43
	20:80	1.70	2.85	6.03	18.10	7.17
	40:60	1.70	3.04	7.15	26.41	9.57
	60:40	1.70	4.25	8.24	35.12	12.33
Artificial	100:00	1.82	2.65	6.20	19.89	7.64
	00:100	1.82	3.58	7.20	27.51	10.03
	10:90	1.82	4.29	8.28	35.45	12.46
	20:80	1.94	2.68	6.47	20.05	7.78
	40:60	1.94	3.67	7.29	27.69^{j}	10.15
	60:40	1.94	4.33	8.37	36.02	12.66
Sunlight	100:00	2.06	2.08	6.76	20.09	7.93
	00:100	2.06	3.78	7.35	27.81	10.25
	10:90	2.06	4.65	8.60	36.28	12.90
	20:80	2.27	3.24	6.83	20.14	8.12
	40:60	2.27	4.16	7.61	27.99	10.51
	60:40	2.27	4.72	8.65	36.83	13.12
Condition x Duration						
Ambient		2.18	2.97	6.39	19.72	7.81^{c}
Artificial		2.18	3.67	7.31	27.58	10.18^{b}
Sunlight		2.18	4.47	8.46	36.16	12.82^{a}
Blend x Duration						
	100:00	3.26	3.99	7.30	28.47	10.76^{a}
	00:100	1.70	3.38	7.14	26.54	9.69^{f}
	10:90	1.82	3.51	7.23	27.62	10.04^{e}
	20:80	1.94	3.56	7.38	27.92	10.20^{d}
	40:60	2.06	3.74	7.57	28.06	10.36^{c}
	60:40	2.27	4.04	7.70	28.32	10.58^{b}
Mean		**2.18**^{d}	**3.70**^{c}	**7.39**^{b}	**27.82**^{a}	-

LSD value for blends: 0.06; LSD value for conditions: 0.05; LSD value for durations: 0.5; Mean in each category followed by different letters are significantly different at P≤0.05

Oil stability

The olive and palm oil samples were kept at ambient condition, artificial light and sunlight. The samples were analyzed at the start of the experiment to record the initial reputation of the oils. These samples were further evaluated after one month interval for three months to record quality constants (PV, FFA, AV, IV, CI and BC) by above mentioned standard methods. Data were analyzed initially for all above quality parameters. Samples were then kept at ambient, artificial and sunlight condition for 90 days.

Statistical analysis

Collected data was analyzed according to procedure appropriate for Complete Randomized Design (CRD) using M-stat software while means values were compared using LSD test when F-value were significant (Steel and Torrie, 1984).

Results and Discussion

Effect of blending, condition and storage time on peroxide value

The individual and combined blending, storage condition and duration on the peroxide value are presented in Table 1. Analysis of variance of data indicated that all the factors alone and in combinations significantly (P≤0.05) affected the peroxide value. The highest peroxide value (10.76 meq kg^{-1}) was noted in sole olive oil. The higher amount of olive oil in blends showed higher value of peroxide. This indicated the natural antioxidants in both olive and palm oil blends decreased the oxidation process compared to olive oil (Siddique et al., 2010). Stress conditions significantly affected peroxide value of both the oils and their mixtures. The highest peroxide value (12.82 meq kg^{-1}) was noted in samples kept in sunlight. Light intensity increased the degree of peroxide value when samples were kept in sunlight, because the oxidation of olive oil resulting increased peroxide value in sunlight (Houlali et al., 2014). The quality of pure and/or blended oils significantly decreased at higher temperatures (Ngassapa et al., 2012). The initial extent of peroxide value was only 2.18 meq kg^{-1} which increased to 3.70 meq kg^{-1} after 30 days revelation period, followed by 7.39 meq kg^{-1} after 60 days interval. The highest peroxide value 27.82 meq kg^{-1} was recorded after 90 days storage

time. The results showed that the extent of peroxide value decreased with increasing amount of palm oil. Sunlight increased the quantity of peroxide value as compared to ambient and artificial conditions. In addition, a positive relation existed between peroxide value and storage time.

Effect of blend, condition and storage time on free fatty acids

The sole along with pooled blending, storage condition and duration on the free fatty acids are presented in Table 2. Statistical analysis of the data indicated that all the three factors alone and in mixture significantly (P≤0.05) affected the free fatty acids. The highest free fatty acids of 2.44% were noted in sole olive oil. High free fatty acid of olive oil adds to increased values of oil blends (Abdulkarim et al., 2010). Stress conditions significantly affected free fatty acids of both the oils and their mixtures. The highest free fatty acids of 1.32% were noted in samples kept in sunlight. The initial free fatty acid was meagrely recorded in samples kept at ambient temperature. However, median free fatty acid was recorded in samples stored at artificial condition. The measurement of hydrolytic rancidity increased due to warmth 60 days of storage. Light concentration increased the amount of free fatty acid when samples were kept in sunlight (Jonida and Kozeta, 2013). The initial extent of free fatty acids was only 0.88%, which increased to 1.19% after 30 days revelation period. However, the highest free fatty acids of 1.47% were recorded after 90 days storage time. The results showed that the extent of free fatty acids decreased with increasing amount of palm oil. Sunlight increased the quantity of free fatty acids as compared to ambient and artificial conditions.

Table 2: *Free fatty acid value of olive and palm oils tested in different blends at various stress conditions during three months exposure*

Condition	Blend (OO:PO)	Duration (days)				Mean
		0	30	60	90	
Ambient	100:00	1.95	2.18	2.50	2.34	2.24
	00:100	1.95	2.57	2.62	2.93	2.52
	10:90	1.95	2.56	2.67	3.02	2.55
	20:80	0.21	0.47	0.63	0.77	0.52
	40:60	0.21	0.63	0.83	0.98	0.67
	60:40	0.21	0.82	0.96	1.06	0.77
Artificial	100:00	0.44	0.63	0.71	0.83	0.65
	00:100	0.44	0.71	0.94	1.04	0.78
	10:90	0.44	0.94	1.04	1.09	0.87
	20:80	0.68	0.81	0.95	0.97	0.85
	40:60	0.68	0.99	1.04	1.03	0.93
	60:40	0.68	1.07	1.26	1.12	1.03
Sunlight	100:00	0.98	1.06	1.20	1.40	1.16
	00:100	0.98	1.12	1.25	1.54	1.22
	10:90	0.98	1.22	1.42	1.52	1.28
	20:80	1.01	1.04	1.31	1.60	1.24
	40:60	1.01	1.25	1.37	1.44	1.27
	60:40	1.01	1.32	1.53	1.72	1.39
Condition x Duration						
Ambient		0.88	1.03	1.22	1.32	1.11^{c}
Artificial		0.88	1.21	1.34	1.49	1.23^{b}
Sunlight		0.88	1.32	1.48	1.59	1.32^{a}
Blend x Duration						
	100:00	1.95	2.44	2.60	2.76	2.44^{a}
	00:100	0.21	0.64	0.81	0.94	0.65^{f}
	10:90	0.44	0.76	0.90	0.98	0.77^{e}
	20:80	0.68	0.95	1.08	1.04	0.94^{d}
	40:60	0.98	1.13	1.29	1.49	1.22^{c}
	60:40	1.01	1.20	1.40	1.59	1.30^{b}
Mean		**0.88**^{d}	**1.19**^{c}	**1.35**^{b}	**1.47**^{a}	-

LSD value for blends: 0.03; LSD value for conditions: 0.02; LSD value for durations: 0.02; Mean in each category followed by different letters are significantly different at P≤0.05

Effect of blend, condition and storage time on anisidine value

The individual and combined blending, storage condition and duration on the anisidine value are presented in Table 3. Analysis of variance of the data indicated that all the factors alone and in combinations significantly (P≤0.05) affected the anisidine value. The highest anisidine value of 2.29 was noted in sole olive oil. However, the increasing rate of olive oil significantly increased the portion of anisidine value (Alamzeb et al., 2008; Mahsa et al., 2010). Stress conditions significantly affected anisidine value of both the oils and their mixtures. The highest anisidine value of 1.39 was noted in samples kept in sunlight. The initial extent of anisidine value was only 1.02, which increased to 1.24 after 30 days revelation period, followed by 1.42 after 60 days interval. The highest anisidine value of 1.56 was recorded after 90 days storage time. The initial inisidine value was corresponding but gradually increased by high temperature after 30, 60 and 90 days storage period. The elevated change was due to sunlight. Anisidine value seems to be linked with cis fatty acids which increased with increase rate of olive oil in blends (Choudhary and Kiran, 2013). The observation showed that the degree of anisidine value

was decreased with increasing the amount of palm oil. Higher temperature like sunlight increased the quantity of anisidine value as compared to ambient and artificial conditions.

Effect of blend, condition and storage time on iodine value

The sole with combined blending, storage conditions as well as duration on the iodine value are presented in Table 4. Statistical examination of the data indicated that all the factors alone and in combinations significantly (P≤0.05) affected the iodine value. The highest iodine value of 77.09 was noted in sole olive oil. Olive oil of 10% and 20% blended with other oils mixer showed best combination for stability of oils (Adel et al., 2011). Stress conditions significantly affected iodine value of both the oils and their combinations. The highest iodine value of 63.10 was noted in samples kept at ambient storage condition. Lowest iodine value was recorded in palm oil kept in sunlight confirming

Table 3: *Anisidine value of olive and palm oils tested in different blends at various stress conditions during three months exposure*

Condition	Blend (OO:PO)	Duration (days)				Mean
		0	30	60	90	
Ambient	100:00	2.02	2.16	2.22	2.35	2.19
	00:100	2.02	2.31	2.38	2.45	2.29
	10:90	2.02	2.46	2.53	2.59	2.40
	20:80	0.57	0.69	0.89	1.07	0.81
	40:60	0.57	0.79	0.97	1.18	0.88
	60:40	0.57	0.94	1.07	1.25	0.96
Artificial	100:00	0.65	0.73	0.97	1.16	0.88
	00:100	0.65	0.81	1.02	1.24	0.93
	10:90	0.65	0.96	1.17	1.31	1.02
	20:80	0.72	0.86	1.04	1.25	0.97
	40:60	0.72	0.95	1.13	1.32	1.03
	60:40	0.72	1.13	1.22	1.42	1.12
Sunlight	100:00	0.91	0.99	1.36	1.41	1.17
	00:100	0.91	1.07	1.43	1.49	1.23
	10:90	0.91	1.21	1.49	1.59	1.30
	20:80	1.22	1.32	1.43	1.52	1.37
	40:60	1.22	1.42	1.53	1.63	1.45
	60:40	1.22	1.56	1.66	1.76	1.55
Condition x Duration						
Ambient		1.02	1.13	1.32	1.46	1.23^{c}
Artificial		1.02	1.23	1.41	1.55	1.30^{b}
Sunlight		1.02	1.38	1.52	1.65	1.39^{a}
Blend x Duration						
	100:00	2.02	2.31	2.37	2.47	2.29^{a}
	00:100	0.57	0.81	0.98	1.17	0.88^{f}
	10:90	0.65	0.83	1.05	1.24	0.94^{e}
	20:80	0.72	0.98	1.13	1.33	1.04^{d}
	40:60	0.91	1.09	1.43	1.50	1.23^{c}
	60:40	1.22	1.43	1.54	1.64	1.46^{b}
Mean		**1.02^{d}**	**1.24^{c}**	**1.42^{b}**	**1.56^{a}**	-

LSD value for blends: 0.02; LSD value for conditions: 0.01; LSD value for durations: 0.02; Mean in each category followed by different letters are significantly different at P≤0.05

Table 4: *Iodine value of olive and palm oils tested in different blends at various stress conditions during three months exposure*

Condition	Blend (OO:PO)	Duration (days)				Mean
		0	30	60	90	
Ambient	100:00	82.78	79.54	78.33	76.50	79.29
	00:100	82.78	77.90	73.74	73.49	76.98
	10:90	82.78	72.73	73.50	71.09	75.02
	20:80	58.05	57.87	56.46	51.08	55.86
	40:60	58.05	47.70	52.16	50.43	52.09
	60:40	58.05	52.30	50.36	48.27	52.25
Artificial	100:00	59.11	58.37	57.78	55.40	57.67
	00:100	59.11	53.62	54.39	52.60	54.93
	10:90	59.11	54.58	52.40	50.20	54.07
	20:80	61.68	60.25	58.62	57.52	59.52
	40:60	61.68	59.05	56.64	54.16	57.88
	60:40	61.68	58.04	55.64	53.12	57.12
Sunlight	100:00	64.71	62.79	61.38	60.17	62.26
	00:100	64.71	61.42	59.21	57.23	60.64
	10:90	64.71	59.40	57.33	55.44	59.22
	20:80	65.98	64.49	63.19	62.47	64.03
	40:60	65.98	62.36	61.45	59.66	62.36
	60:40	65.98	60.78	58.08	56.15	60.25
Condition x Duration						
Ambient		65.38	63.89	62.63	60.52	63.10^{a}
Artificial		65.38	60.34	59.60	57.93	60.81^{b}
Sunlight		65.38	59.64	57.88	55.71	59.65^{c}
Blend x Duration						
	100:00	82.78	76.72	75.19	73.69	77.09^{a}
	00:100	58.05	52.62	52.99	49.93	53.40^{f}
	10:90	59.11	55.52	54.86	52.73	55.56^{e}
	20:80	61.68	59.11	56.97	54.93	58.17^{d}
	40:60	64.71	61.20	59.31	57.61	60.71^{c}
	60:40	65.98	62.55	60.91	59.43	62.21^{b}
Mean		**65.4^{a}**	**61.3^{b}**	**60.0^{c}**	**58.1^{d}**	-

LSD value for blends: 0.64; LSD value for conditions: 0.45; LSD value for durations: 0.52; Mean in each category followed by different letters are significantly different at P≤0.05

the effect of storage temperature on the quality of oils (Wiesman, 2009). The initial extent of iodine value was only 65.38, which decreased to 61.29 after 30 days revelation period, followed by 60.04 after 60 days interval. The lowest iodine value of 58.05 was recorded after 90 days storage time.

The results showed that the extent of iodine value decreased with increasing amount of palm oil. Sunlight decreased the quantity of iodine value as compared to ambient and artificial conditions. In addition, a negative relation existed between iodine value and storage time.

Table 5: *Colour index of olive and palm oils tested in different blends at various stress conditions during three months exposure*

Condition	Blend (OO:PO)	Duration (days)				Mean
		0	30	60	90	
Ambient	100:00	0.647	0.640	0.620	0.510	0.604
	00:100	0.647	0.630	0.603	0.590	0.617
	10:90	0.647	0.603	0.590	0.580	0.605
	20:80	0.163	0.160	0.150	0.140	0.153
	40:60	0.163	0.150	0.140	0.130	0.146
	60:40	0.163	0.140	0.130	0.120	0.138
Artificial	100:00	0.320	0.300	0.277	0.270	0.292
	00:100	0.320	0.290	0.280	0.260	0.287
	10:90	0.320	0.277	0.270	0.260	0.282
	20:80	0.360	0.350	0.357	0.320	0.347
	40:60	0.360	0.340	0.330	0.303	0.333
	60:40	0.360	0.313	0.300	0.290	0.316
Sunlight	100:00	0.370	0.360	0.350	0.340	0.355
	00:100	0.370	0.340	0.340	0.320	0.342
	10:90	0.370	0.327	0.320	0.307	0.331
	20:80	0.490	0.473	0.470	0.460	0.473
	40:60	0.490	0.470	0.360	0.440	0.440
	60:40	0.490	0.450	0.347	0.430	0.429
Condition x Duration						
Ambient		0.392	0.381	0.371	0.340	0.371[a]
Artificial		0.392	0.370	0.342	0.341	0.361[b]
Sunlight		0.392	0.352	0.326	0.331	0.350[c]
Blend x Duration						
	100:00	0.647	0.624	0.604	0.560	0.609[a]
	00:100	0.163	0.150	0.140	0.130	0.146[f]
	10:90	0.320	0.289	0.276	0.263	0.287[e]
	20:80	0.360	0.334	0.329	0.304	0.332[d]
	40:60	0.370	0.342	0.337	0.322	0.343[c]
	60:40	0.490	0.464	0.392	0.443	0.447[b]
Mean		**0.39[a]**	**0.37[b]**	**0.35[c]**	**0.34[d]**	-

LSD value for blends: 0.0005; LSD value for conditions: 0.0003; LSD value for durations: 0.0004; Mean in each category followed by different letters are significantly different at P≤0.05

Effect of blend, condition and storage time on colour index

The alteration in colour of the oils is an image sign of the degree of oil worsening caused by corrosion. All single and combined effects of blended oils significantly affected the colour of the oils. In this study, colour index of olive: palm oil blends showed highly significant variances tested under different storage conditions. The highest colour index of 0.609 was noted in sole olive oil (Table 5). The change in colour may due to the high content of linoleic acid in OO oil reproduce high values of colour in blended oils. Stress conditions significantly affected the colour index of both the oils and their mixtures. The highest colour index of 0.371 was noted in samples kept at ambient condition. Higher temperature along with longer storage period decreased the amount of colour (Pantzaris, 1998). The initial extent of colour index was only 0.392, which decreased to 0.367 after 30 days revelation period, followed by 0.346 after 60 days interval. The lowest colour index of 0.337 was recorded after 90 days storage time. The results showed that the extent of colour index decreased with increasing amount of palm oil. Sunlight decreased the quantity of colour index as compared to ambient and artificial conditions. In addition, a negative relation existed between colour index and storage time.

Effect of blend, condition and storage time on β-carotene value

The sole and combined blending, storage condition and duration on the β-carotene value are presented in Table 6. Statistical analysis of the data revealed that all the factors alone and in combinations significantly (P≤0.05) affected the β-carotene value. The highest β-carotene value of 12.61 was noted in sole palm oil. Stress conditions significantly affected β-carotene value of both the oils and their mixtures. The highest β-carotene value of 11.30 was noted in samples kept at ambient condition. The oil samples stored at low temperature were found to be positivly affected by to olive oil compared to sunlight, which caused reduction of carotenoids (Alamzeb et al., 2008). The initial extent of β-carotene value was 27.87, which decreased to 5.28 after 30 days revelation period. The lowest β-carotene value of 3.46 was recorded after 90 days storage time. The results showed that the extent

of β-carotene value decreased with increasing amount of palm oil. Sunlight decreased the quantity of β-carotene value as compared to ambient and artificial conditions. In general, a negative relationship survived between β-carotene value and storage period.

Table 6: *Beta carotene value of olive and palm oils tested in different blends at various stress conditions during three months exposure*

Condition	Blend (OO:PO)	Duration (days)				Mean
		0	30	60	90	
Ambient	100:00	24.71	5.16	4.31	3.60	9.44
	00:100	24.71	4.40	3.40	2.50	8.75
	10:90	24.71	3.25	2.65	1.13	7.93
	20:80	31.11	8.52	8.11	7.15	13.72
	40:60	31.11	7.13	6.11	5.78	12.53
	60:40	31.11	6.27	5.67	3.21	11.57
Artificial	100:00	30.13	7.29	6.51	6.00	12.48
	00:100	30.13	6.09	5.15	4.51	11.47
	10:90	30.13	5.15	4.32	2.14	10.44
	20:80	28.74	6.25	6.01	5.21	11.55
	40:60	28.74	5.22	4.37	3.56	10.47
	60:40	28.74	4.13	3.44	1.48	9.45
Sunlight	100:00	26.87	5.80	5.51	4.13	10.58
	00:100	26.87	4.62	3.53	3.00	9.50
	10:90	26.87	3.51	3.05	1.36	8.70
	20:80	25.68	5.42	5.00	4.00	10.02
	40:60	25.68	3.90	2.97	2.42	8.74
	60:40	25.68	2.86	2.43	1.12	8.02
Condition x Duration						
Ambient		27.87	6.41	5.91	5.01	11.30[a]
Artificial		27.87	5.23	4.25	3.63	10.25[b]
Sunlight		27.87	4.19	3.59	1.74	9.35[c]
Blend x Duration						
	100:00	24.71	4.27	3.45	2.41	8.71[f]
	00:100	31.11	7.31	6.63	5.38	12.61[a]
	10:90	30.13	6.17	5.33	4.22	11.46[b]
	20:80	28.74	5.20	4.61	3.41	10.49[c]
	40:60	26.87	4.64	4.03	2.83	9.54[d]
	60:40	25.68	4.06	3.46	2.51	8.93[e]
Mean		**27.87**[a]	**5.28**[b]	**4.58**[c]	**3.46**[d]	-

LSD value for blends: 0.22; LSD value for conditions: 0.15; LSD value for durations: 0.18; Mean in each category followed by different letters are significantly different at P≤0.05

Conclusions

On the basis of the results obtained, it was concluded that mixing different proportions (10:90%, 20:80%, 40:60% and 60:40% v/v) of olive oil with palm oil provided enhancement in anti-oxidative success of edible oils. Besides, sunlight encouraged the acidity of olive oil and its oxidation. The oil blends would have longer shelf life stability and additional dietary value compared to sole oil. The blending of oils stabilize the edible oils, enhances the dietetic and efficient qualities of the oils by come together the high-quality of the two oils in to one. It was concluded that olive oil and palm oil mixed at a level of 10:90 and 20:80% have the best quality parameters subsequent to 20:80% olive: palm oil blend is more suitable and better to other blends merging both stability and financial system.

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Authors' Contribution

The first (also main) author of this research article contributed in oils samples collection, laboratory analysis of oils in different stress and storage conditions, statistical analysis of the recorded data of the different quality parameters of oils blends, composing of the manuscript while the co-author provide office and laboratory facilities and check the first draft of this manuscript.

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