

A Research about Determination of the Quality of Feed Oils Used as Mixed Feed Raw Material from Some Feed Factories in Konya-Turkey

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Abstract—Feed oil samples which are used as mixed feed raw material were taken from six different feed factories in March, May and July. All factories make production in Konya, Turkey and all of the samples were crude soybean oils. Physical and chemical analyses, free radical scavenger effect, and total phenol content were determined on these oil samples. Moisture (M) content was found between 0.10-22.23%, saponification number (SF) was determined 143.13 to 167.93 KOH/kg, free fatty acidity (FFA) was varied 0.73 to 35.00%, peroxide value (PV) was found between 1.53 and 28.43 meq/kg, unsaponifiable matter (USM) was determined from 0.40 to 17.10%, viscosity (V) was found between 34.30 and 625.67 mPas, sediment (S) amount was determined between 0.60-18.16%, free radical scavenger effect (FRSE) was varied 20.7 to 43.04% inhibition of the extract and total phenol (TPC) content was found between 1.20 and 2.69mg/L extract. Different results were found between months and factories.

Keywords—Crude soybean oil, Feed oils, mixed feed.

I. INTRODUCTION

OILS and fats are one of the raw materials used in mixed feed production. Oils and fats are resources of biological energy. They take part in membrane of cells and have structural function, they are isolated body against warm and cold as take part in skin and they are isolated to nerve cells as electrical, provide absorption and transportation of vitamins of soluble (A,D,E,K) in oils and fats, they are source of essential fatty acid linoleic. Linoleic acid is an essential fatty acid for poultry [1]. Oils and fats provide a homogeneous forage mixture in terms of feed technology. Previous studies showed heavy metals tend to decomposition in feed, to add 1-2% oils or fat in forage can prevent decomposition. Oils and fats prevent pollination in forages. Pollination causes loss of nutrients in feed, to add 1-2% oil sufficient is enough to prevent the pollination. To add oil and fat in forage gives flavor, however feed flavor is not important factor for poultry but also they increase flavor for other livestock. Oils added to feed prevent erosion of machines, oils makes easier to make

pellet and in terms of poultry to add oil in feed is important factor that reduces heat stress [1]. Because of these reasons, oils provide advantage in animal feed and often used. Also oils and fats used at mixed feed factories both to raise energy value and to reduce cost of feed and to increase the necessary amount of fatty acids in forage with the other advantages on forage technologies. Today vegetable crude oils (soybean oil, cotton oil, sunflower oil, peanut oil, corn oil, canola oil, palm oil, olive oil, coconut oil, palm seed oil), animal fats (rendering, lard, tallow, chicken fat and fish oil), restaurant oils, acid oils and mixed oils use in animal feeding. Some matters should be considered for to take good results for human and animal health about used oils and fats in mixed feed. The quality criteria of feeding oil should be determine in process and should not be add oils that may be spoil taste, odor of animal products and that may cause health problems for animals. Oils and fats used at animal feed can be oxide during by process and storage, nutrition value can be reduce, toxic matter content may increase. Oxidized cholesterol amount of different feed formulations can change the level of oxidized products in animal tissues [2].

Quality of oils and fat used in animal nutrition effects product of animal therefore human health and because of these reasons in this research is intended to determine of oils and fats used to produce feed of conditions in Konya, Turkey.

II. MATERIALS AND METHODS

A. Materials

Materials were obtained from six feed factory in March, May and July 2010, to once in a month. Oils were stored at 4°C. All of oils were obtained crude soybean oils.

B. Methods

1. Assessment of Instrumental Color

Colorimeter (Minolta Chroma meter CR 400 (Minolta Co., Osaka, Japan) was used to assess the oil color and the CIELAB colorimetric [3].

2. Viscosity Measurements

The viscosity of the oils was measured using vibro-viscometer (SV- 10; A & D Co., Ltd., Tokyo, Japan).

3. Sediment Measurements

10 gr of oil samples were weighted and put in 100 ml beaker and added solvent, filtered under vacuum, residues were weight and Results were reported as % sediment [1].

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4. Moisture Measurement

Moisture content of oils was determined by removing water from samples in oven at 105°C. Results were reported as % moisture [4].

5. Determination of Free Fatty Acid (FFA) and Peroxide Value (PV)

Free fatty acids and peroxide value of soybean oils were determined following the analytical methods described in Regulation European Economic Commission. Free fatty acids, given as percent of oleic acid, were determined by titration of a solution of oil dissolved in ethanol/ether (1:1, v/v) with 0.1 mol L⁻¹ potassium hydroxide ethanolic solution. Peroxide value, expressed in mill equivalents of active oxygen per kilogram of oil (meq kg⁻¹), was determined as follows: A mixture of oil and chloroform-acetic acid was left to react with a solution of potassium iodide in darkness; the free iodine was then titrated with a sodium thiosulfate solution [5].

6. Unsaponifiable Matter

Oils samples were treated with 2N ethanol KOH solution and washed with Petroleum ether and ethanol, quantity of soluble matter in these solutions were determined as Unsaponifiable matter [4].

7. Number of Saponification

Samples of oils were saponified with 0.5N ethanol KOH solution and unused KOH was titrated against to 0.5 N HCL [5].

8. Extraction of Phenolic Contents

Briefly, 2 g of oil were weighed in a centrifuge tube and added with 1 ml of n-hexane and 2.0 ml of CH₃OH-water (60:40, v/v). The mixture was stirred for 2 min in a vortex apparatus, and the tube was centrifuged at 3000 rev./min (30 cm diameter) for 5 min. The methanol layer was separated and

the extraction repeated twice. The extracts were combined and evaporated to dryness under reduced pressure and low temperature (<35°C). Samples were dissolved in 1 ml of CH₃OH-water (1:1, v/v) and filtered through a 0.45 µm nylon filter for capillary electrophoresis analysis [6], [7].

9. Determine the Amount of Total Phenolic Content

The total phenol content of extracts was determined by the Folin-Ciocalteu spectrophotometric method at 750 nm [20], using a gallic acid calibration curve. The spectrophotometric analysis was repeated three times for each extract (n=3) [7].

10. Determination of the Effect of Free Radical Scavenger

Extracts used for total phenolic content determination of % inhibition calculation of DPPH free radical [8].

11. Statistical Analysis

Evaluation of the data obtained as a result of the research program of the SAS package with a single factor analysis of variance (completely randomized) trial according to the plan made. Each session features examined in the analysis of the differences between the factories were analyzed according to statistical model of Y_{ij}: M + e_i + E_{ij}. Distinguishing the different groups (spelling) Duncan's multiple range tests was used [9].

Y_{ij}: surveyed property

e_i = the effects of factories

E_{ij} = random error

III. RESULTS AND DISCUSSION

Chemical and physical analysis results are shown in Tables I and II. Total phenolic content and free radical scavenger effect results are shown in Table III.

TABLE I
SOME CHEMICAL ANALYSES RESULTS

	M(%)	SN (KOH/kg)	FFA (%)	PV (meq/kg)	USM (%)
MARCH					
F1	0.10±0.005c	165.87±0.45ba	1.10±0.05e	8.80±0.40c	0.60±0.05g
F2	0.07±0.05c	167.13±0.05a	0.93±0.05e	8.13±0.15c	1.00±0.05e
F3	0.03±0.05c	165.06±0.80ba	0.73±0.05e	6.60±0.10d	1.23±0.05d
F4	0.13±0.05c	167.93±0.50a	35.00±0.40b	15.87±1.70a	0.77±0.05f
F5	22.23±0.75a	143.13±0.05c	11.37±0.15c	8.03±0.05c	2.40±0.05b
F6	1.83±0.15b	148.17±3.10c	1.63±0.05d	12.6±0.10b	1.60±0.05c
MAY					
F1	0.30±0.03ba	165.50±0.60a	2.43±0.05c	10.60±0.60e	0.50±0.10c
F2	0.50±0.02a	165.57±1.60a	1.20±0.10d	10.90±0.05e	0.50±0.10c
F3	0.10±0.01b	165.90±2.70a	1.26±0.15d	13.30±0.10d	0.60±0.05c
F4	0.16±0.05ba	164.60±3.00a	3.90±0.10b	18.26±0.05b	1.10±0.05b
F5	0.36±0.03ba	164.73±3.30a	33.10±0.10a	28.43±0.15a	0.60±0.05c
F6	0.20±0.01ba	150.63±1.50b	4.10±0.20b	9.53±0.35f	16.60±0.60a
JULY					
F1	0.60±0.05c	165.03±2.50b	3.26±0.05c	2.20±0.05d	0.40±0.05d
F2	0.10±0.01bc	180.76±5.50a	2.50±0.01d	2.00±0.05e	0.40±0.02d
F3	0.03±0.05c	166.53±4.00b	1.36±0.57g	2.33±0.05c	0.60±0.05c
F4	0.27±0.05a	165.03±2.35b	12.83±0.05b	4.00±0.05b	1.00±0.10b
F5	0.10±0.01bc	165.67±3.35b	33.97±0.05a	6.00±0.05a	0.60±0.05c
F6	0.10±0.01bc	150.26±3.45c	2.40±0.05e	1.53±0.05f	17.10±0.10a

F: Factory. a, b, c values in rows are statistically different; P<0.05

Chemical analyses results were evaluated in terms of months the highest moisture was found in March at F5 (22.23%), the highest saponification number was determined in July at F2 (180.76 KOH/kg), the highest free fatty acidity was detected in March at F4 (35.00%), the highest peroxide value was found in May at F5 (28.43 meq/kg) and the highest unsaponifiable matter was determined in May and July at F6 (16.60-17.10%). According to these results, an evaluation was made and in terms of chemical analyses wasn't determined regular changes between months. Results were evaluated according to factories moisture had significant at F5, free fatty acidity significantly high at F4 and F5, peroxide value had significant at F4, F5 and F6, Unsaponifiable matter had significant at F5 and F6. In terms of chemical analysis of the feed oil used in the factory results in large differences are observed. Reference [10] shows results about moisture at 20 different soybean oils and reported the lowest value as 0.08% and the highest value as 0.13%. As general moisture values of used soybean oils in this research were similar. Reference [11] determined some chemical properties at soybean oils of obtained using different methods. According to results of this study they were reported saponification numbers respectively

as 195,195 and 198KOH/kg at soybean oils using methods of hexane. Reference [12] reported saponification number of deodorized crude soybean oil as 159.4KOH/kg in a research. Reference [13] shows free fatty acidity values at soybean oils of obtained using different extraction methods. The results of this research were determined free fatty acid values as 2.80% and 3.31% at crude soybean oils of using reflux extractor and soxhlet, respectively. Reference [12] found fatty acid value of deodorized crude soybean oil as 53.8%. Reference [10] reported peroxide value of soybean oils stored at the end of 7 days of stored as 25.0meq/kg and at the end of 14 days of stored as 45.0meq/kg and at the end of 21 days of storage as 55.0meq/kg in a research for determined relation between storage and peroxide value. Reference [14] shows as 0.5 meq/kg peroxide value of soybean oil. Reference by [12] researchers were found unsaponifiable matter as 20,1% of deodorized soybean oil. Reference [11] shows unsaponifiable matter was determined between 0.3-0.5% at soybean oils of obtained with three different extraction methods. The results of the previous researches reported that analyses results could be effected by obtain process methods of soybean oil.

TABLE II
SOME PHYSICAL ANALYSES RESULTS

	L*	a*	b*	V (mPas)	S(%)
MARCH					
F1	65.26±1.52a	-5.76±1.98c	63.68±4.66ba	46.27±0.90c	1.96±0.05b
F2	65.36±3.27a	-6.05±0.21c	67.41±4.26a	41.83±0.23c	1.10±0.10e
F3	64.65±1.84a	-5.38±0.57c	54.27±3.85b	45.70±1.28c	0.95±0.05f
F4	40.28±2.41b	6.20±1.13a	17.89±1.50dc	625.67±13.10a	7.30±0.05a
F5	60.04±1.53a	-1.34±0.20b	20.98±2.10c	65.56±0.70c	1.20±0.01d
F6	67.44±1.82a	-5.69±0.50c	64.09±2.08ba	49.66±0.60c	1.86±0.05c
MAY					
F1	59.33±4.07ba	-5.29±1.18c	44.49±2.41ba	39.13±0.65a	0.63±0.05e
F2	61.95±0.51ba	-6.49±0.15d	48.01±0.89ba	39.46±0.72a	0.60±0.01e
F3	57.60±4.46b	-4.29±0.54cb	42.06±3.51b	39.06±0.56a	0.80±0.05d
F4	57.22±2.64b	-2.22±0.53a	25.87±2.04c	56.53±1.37a	1.13±0.05c
F5	60.06±0.9ba	-3.48±0.31b	20.20±1.83c	37.30±0.60a	0.60±0.05e
F6	62.83±1.56a	-5.48±0.85cd	49.27±2.21a	42.50±0.20a	18.16±0.15a
JULY					
F1	56.37±2.58b	-4.31±0.81cb	38.66±3.98b	44.80±2.30b	6.80±0.10a
F2	64.03±2.60b	-4.94±1.73c	53.45±1.42b	43.86±1.36cb	1.03±0.05d
F3	64.39±2.55b	-7.32±0.81d	50.71±4.04b	38.63±1.65d	1.00±0.01d
F4	63.48±3.13b	-0.44±0.03a	46.32±0.50b	49.86±1.66a	4.00±0.10b
F5	60.59±2.98b	-2.77±0.42b	19.10±2.19c	34.30±0.70e	3.40±0.01c
F6	56.03±2.33b	-3.67±1.10cb	38.52±1.04b	41.96±0.92c	0.86±0.05e

F: Factory. a, b, c values in rows are statistically different; P<0.05

Results of physical analyses were shown at Table II. According to data for L* value had significant between factories in March and May but had not significant in July. The highest a* value were determined in March at F4 (6.20) and the lowest a* value were determined in July at F3 (-7.32). The b* value results were found the lowest and highest in March at F4 (17.89) and at F2 (67.41), respectively. To obtained soybean oil by the different factories in May had not significant effect on viscosity results of soybean oils but significant in March and July. The highest viscosity result

found in March at F4 (625.67 mPas). Sediment results had significantly affected by among factories in March, May and July. The highest sediment value was found at F6 (18.16 %) in May. Reference [12] shows L* value was found as 52.46 of deodorized soybean oil. Reference [15] reported that L* value was found 67.64 of crude soybean oil obtained in laboratory, 88.38 of industrial crude soybean oil and 95.87 of refined soybean oil, respectively. They were reported that a* values were found 13.92, 7.40 and -7.40 obtained by crude soybean oil obtained at laboratory, industrial crude soybean oil and

refined soybean oil, respectively. Reference [12] shows that b* value found 77.43 from deodorized crude soybean oil. Reference [15] stated that b* values were found 102.96, 133.3 and 33.19, crude soybean oil obtained at laboratory, industrial crude soybean oil and refined soybean oil, respectively. Reference [16] reported that viscosity value as 717 mPas of crude soybean oil obtained using ethanol extraction method and as 176 mPas of crude soybean oil obtained using hexane extraction method. Reference [17] reported that high sediment amount of oils in Turkey however we found any studies about this analyses.

TABLE III
FREE RADICAL SCAVENGER EFFECT AND TOTAL PHENOL CONTENT

	Free Radical Scavenger Effect (%) inhibition of the extract)	Total Phenol Content (mg/L extract)
MARCH		
F1	24.08±0.75b	1.24±0.04dc
F2	43.04±1.01a	1.26±0.01dc
F3	25.50±0.66b	1.09±0.01d
F4	26.02±1.64b	1.48±0.09c
F5	25.00±1.56b	1.77±0.07b
F6	25.13±0.86b	1.44±0.13c
MAY		
F1	24.00±1.08bc	1.31±0.14cb
F2	24.67±0.36b	1.20±0.12c
F3	23.92±0.94bc	1.27±0.09cb
F4	21.87±0.62c	1.40±0.05b
F5	23.46±1.57bc	1.88±0.05a
F6	25.68±0.49ba	1.80±0.02a
JULY		
F1	25.34±0.83c	1.55±0.01cbd
F2	20.75±0.01d	1.65±0.18cb
F3	25.10±0.78c	1.37±0.06d
F4	28.25±1.02ba	1.71±0.04b
F5	27.14±1.83bac	2.69±0.32a
F6	28.63±1.23a	1.61±0.02cbd

F: Factory, a, b, c values in rows are statistically different; P<0.05

Results of free radical scavenger effect and total phenol content were shown Table III. Free radical scavenger effect results were determined by the highest in March at F2 (43.04 %). The highest value of total phenol content was found in July at F5 (2.69 mg/L).

Reference [18] shows that free radical scavenger effect was found 54.4 for soybean oil of 9 different oils. Reference by [19] were analyzed free radical scavenger effect and total phenol content of crude soybean oil, sunflower oil and corn oil obtained using cold extraction method. This study results reported that free radical scavenger at soybean oil, sunflower oil and corn oil respectively as 17.4, 23.8, 11.1 and for total phenol content values were detected at soybean oil as 1.48, at sunflower oil as 1.20 and at corn oil as 1.26. Results of free radical scavenger effect and total phenol content in our study consistent with previous researches.

IV. CONCLUSION

In this research results of crude soybean oils taken from feed factories were determined sediment amount as generally

high. In this reason we can say may be dust, plant residue or else matters inside oils. This is an important situation which may affect the quality of forage. In addition, the analysis of oils obtained from the results have parallel features compared to previous studies, factories received more of the viscosity of oils, moisture, free acidity and peroxide number analysis results and the very high fat diets concluded that there is no standardization and control or no appropriate storage conditions for oils which taken to plants each month. Forage quality is an important factor in the quality of the feed oils and fats made extensive studies in animal feeding trials established by the detection of relevant research is needed.

REFERENCES

- [1] N. Şenköylü, "Yemlik Yağlar (Feed oils), *Textbook* ISBN 975-93691-1-7", 2001, Trakya University-Tekirdağ, Turkey.
- [2] S.J.K.A. Ubhayasekera, P.C. Dutta, "Sterols and sterol oxidation in feeding obtained from co- and by-products from the food chain in Europe", AOCs, 2008, *Annual Meeting-Seattle*, Washington-USA.
- [3] C. Romero, M. Brenes, P. Garcia, A. Garrido, "Hydroxytyrosol 4-β-D-glucoside, an important phenolic compound in olive fruits and derived products", 2002, *J Agric Food Chem.*, pp-50: 3835-3839.
- [4] Anonymous, "Türk Standartları Enstitüsü (Turkish standards Institution), *Edible Oil Inspection Methods 4th Edition*" 1973, Turkey.
- [5] Anonymous, "IOOC (*International Olive Oil Council*)", 2001.
- [6] F.M. Pirisi, P. Cabras, C.F. Cao, M. Migliorini, M. Magelli, "Phenolic compounds in virgin olive oil. 2. Reappraisal of the extraction, HPLC separation, and quantification procedures", 2000, *Journal Agriculture Food Chemistry*, pp-48: 1191-1196.
- [7] M. Bonoli, M. Montanucci, T.G. Toschi, G. Lercker, "Fast separation and determination of tyrosol, hydroxytyrosol and other phenolic compounds in extra-virgin olive oil by capillary zone electrophoresis with ultraviolet-diode array detection", 2003, *Journal Chromatography A*, pp- 1011: 163-172.
- [8] M.A. Gyamfi, M. Yonamine, Y. Aniya, "Free radical scavenging action of medical herbs from Ghana: *Thonningia sanguinea* on experimentally-induced liver injuries", 1999, *General Pharma*, pp- 32(6): 661-667.
- [9] O. Düzgüneş, T. Kesici, F. Gürbüz, "İstatistik Metotları (Statistical Methods) University of Ankara. Agriculture Faculty *Textbook* Number 861", 1984, Ankara-Turkey.
- [10] N. Gámez-Meza, J.A. Noriega-Rodríguez, L. A. Medina-Juárez, J. Ortega-García, R. Cázarez-Casanova, O. Angulo-Guerrero, "Effects of processing on the oxidative stability of soybean oil produced in Mexico", 1998, *Journal of the American Oil Chemists' Society*, pp-75(12): 1729-1733.
- [11] S.H. Yoon, H.I. Kim, "Effect of Extraction Solvents on Oxidative Stability of Crude Soybean Oil", 1990, *Journal of the American Oil Chemists' Society*, pp- 67(3): 165-167.
- [12] C.I. Benites, V.O. Cardenas, S.M.P.M. Reis, A.C. Oliveira, "Physicochemical Characterization of Soybean Oil Deodorizer Distillate", 2010, *Journal of the American Oil Chemists' Society*, pp-88: 267-273.
- [13] N.C. Nikolic, S.M. Cakic, S.M. Novakovic, M.D. Cvetkovic, M.Z. Stankovic, "Effect of extraction techniques on yield and composition of soybean oil", 2009, *Macedonian Journal Chemistry and Chemical Engineering*, pp-28(2): 173-179.
- [14] N.S. Susheelamma, M.R.Asha, R. Ravi, V. Kumar, "Comparative studies on Physical Properties of Vegetable Oils and Their Blends after Frying", 2002, *Journal of Food Lipids*, pp-9 (4): 259-276.
- [15] C.D. Ceballos, L.M. Giacomelli, M. Mattea, "Analysis and Characterization of Edible Oils by Chemometric Methods", 2006, *Journal of the American Oil Chemists' Society*, pp-83(4): 303-308.
- [16] R.C. Larock, M.D. Refvik, Q. Tion, "Ruthenium-Catalyzed Metathesis of Vegetable Oils", 1999, *Journal of the American Oil Chemists' Society*, pp- 76(1): 93-98.
- [17] A. Kubaş, I.I. Hakkı, Ö. Azabağaoğlu, "Türkiye'de bitki silyağ sektörünün karşılaştığı temel sorunlar" 2002, *Turkey 1th Oil seed, Vegetable oils and Technology Symposium*, İstanbul-Turkey.

- [18] A.S. Bhatnagar, P. K. Kumar, J. Hemavathy, A.G. Krishna, "Fatty Acid Composition, Oxidative Stability, and Radical Scavenging Activity of Vegetable Oil Blends with Coconut Oil", 2009, *Journal of the American Oil Chemists' Society*, pp-86: 991-999.
- [19] A. Siger, M.N. Kalucka, E.L. Szczapa, "Phenolic Compounds in Cold Pressed Plant Oils" 2008, *Journal of Food Lipids*, pp-15: 137-149.
- [20] V.L. Singleton, J.A. Ross, "Colorimetry of total phenolics with Phosphomolybdic-phosphotungstic acid reagent", 1965, *Am. J. Enol. Vitic.*, p-16: 144-58