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Effect of Commercial Kebab Frying on Physico-Chemical Parameters of the Tallow

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Abstract: In Pakistan, especially in NWFP tallow is used as commercial deep-frying agent for the traditional fast foods chapli and Shami kebabs and is widely accepted for its color, flakiness, flavor and tenderness. The effect of 10 h continuous commercial kebab frying on the physiochemical parameters of the tallow was studied and evaluated. The tallow was evaluated for ash%, Peroxide Value, Optical Density, Conjugated Dienes, Conjugatet Ttrienes, %FFA, Acid Value and Anisidine Value after 0, 2, 4, 6, 8 and 10 h of frying and the effect of frying kebab resulted in the increase of all these parameters. Results of the linear regression model suggest that frying kebabs have significant correlation with the oxidation of tallow and continuous frying for more than 10 h is not recommended. It is also concluded that kebab frying accelerate the thermal oxidation of the tallow. The results obtained in this experiment propose that POV can be adopted as the standard factor in the evaluation of oxidation of tallow used for the frying kebab and the upper limit will be determined as 28 meq/kg.

Key words: Tallow, kebab, frying, optical density, anisidine value, free fatty acids

INTRODUCTION

It is well established that oxidized fats and oils are toxic (Frankel *et al*., 1984; Lamboni *et al*., 1998; Gotoh *et al*., 2007). Frying is one of the oldest methods known to human kind for preparing food. Fried foods are among the favorites for people around the world (Dunford, 2006). Tallow plays an important role in a balanced diet and in the manufacture of food products contributing to texture and palatability. It is a valuable source of concentrated energy and essential fatty acids needed for growth and development (Ali *et al*., 2008; Zeb and Ali, 2008).

Frying fats are exposed to air oxygen and steam at relatively high temperatures between 160-180°C during frying. Therefore, they are gradually deteriorated by hydrolytic and oxidative processes (Firestone *et al*., 1991). Although the mechanisms for deterioration of fats are essentially the same in different fats during frying, the rates at which these fats undergo various deteriorative reactions vary (Augustine *et al*., 1989). Many studies reported the formation of toxic compounds in oxidized fats and oils. For example, 4-hydroxy-trans-2-nonenal is a strong toxic compound in oxidized fats and oils in heated cooking oil (Seppanen and Csallany, 2004). These toxicities have been evaluated by general toxicity tests such as acute toxicity, subacute and chronic toxicity tests. Oxidized fats and oils are also reported to be neurotoxic (Gotoh *et al*., 2006).

In Pakistan, tallow is mostly rendered at the slaughterhouses using the conventional methods that have been used for the centuries. This rendered fat is then used widely for the edible and frying purposes especially for frying kebabs, which is one of the mostly available traditional fast food of the Pakistan (Ali *et al*., 2008). Tallow is used, for hundreds of years, as a major fat for frying kebab and is widely accepted for its color, flakiness, flavor and tenderness (Zeb and Ali, 2008). Commercially kebabs are fried at the fast food services centers and are offered while hot. However, the information about the frying stability of the tallow during Kebab frying is not available.

This study aimed to investigate the changes in physiochemical characteristics of the local tallow under commercial frying conditions. Changes in physiochemical parameters like Peroxide Value (POV), Optical Density (OD), Conjugated Dienes (CD), Conjugated Trienes (CT), Free Fatty Acids (%FFA), % ash and Anisidine Value (An-V) were determined after 0, 2, 4, 6, 8 and 10 h after frying.

MATERIALS AND METHODS

Tallow samples were obtained from the local market. All analytical reagents used for analysis were obtained either from Merck (Darmstadt, Germany) or Sigma Aldrich (Buchs, Switzerland).

Frying Experiment: Frying was performed at the local fast food services center at Chakdara, NWFP, Pakistan. Six kilograms of the tallow was taken in a kettle used for the commercial frying of kebabs and was heated. When the temperature of the tallow reached 180°C, a batch of kebabs was fried in it. One batch of the kebabs contained four kebabs of equal weight (125 g) as the requirements of the market and six fryings were performed per hour. Total of sixty fryings were performed in 10h and 60 g tallow sample was collected after each

2 h for the determination of the physiochemical parameters which were stored at 0°C. The maximum frying time for each batch of kebabs was 10 min depending on the experience of the fryier.

Determination of physicochemical parameters: Acid Value, % free fatty acids (%FFA), Anisidine value (An-V) and peroxide of the tallow were determined by various standard AOCS methods (1972). Ash Value was determined by method described for the tallow by (Ali *et al*., 2008). For the determination of the Optical Density (OD) the absorbance of 1:5 (Wt/V) ratio of fats and solvent was measured at 420 nm against the blank with the help of Shimadzu UV-1600 spectrophotometer. The degree of oxidation of tallow was also measured spectrophotometrically by determining the absorption value at 232 nm and 270 nm for conjugated dienes and trienes, respectively.

Statistical analysis: All the parameters were determined at least in triplicate and data was presented as mean± SD. The data was analyzed for regression and correlation by using SPSS version 12.0 software package.

RESULTS AND DISCUSSION

Anisidine Value (AV): The relationship of the AV with the frying time is shown in Fig. 7. The average Anisidine Value (AnV) of the control tallow was 7.95±2.291 which is the lowest. The highest AV (131.304±71.363) for the tallow was observed after 10 h of kebab frying. The results show a strong relationship (r = 0.955) between the AV and frying time. The control samples of the tallow have the AV less than 10 which reflect its good quality. An-V is one of the methods used to quantify secondary oxidation products of the oil by measuring the aldehydes, principally 2,4-dienals (Augustine and Chong, 1986; Zeb and Lutfullah, 2005). Since oxidation is increased during frying, theoretically An-V should also increase (Che Man *et al*., 1999). The results of the frying kebab in the tallow are in agreement with this notion.

Optical Density (OD): The lowest OD (0.519±0.24) was observed for the control tallow while the highest (3.237+0.02) was observed after 10 h of frying. The results show a strong relationship (r = 0.979) between the OD and frying time. The increase in color content was attributed to the alpha, beta-unsaturated carbonyl compounds, which are intermediates to give nonvolatile decomposition products containing carbonyl group and have the ability to absorb energy of the magnitude of visible light (Gutierrez *et al*., 1988). Significant increase in color of the olive oil and corn oil after 8 and 6 h of frying potato respectively was found (Chatzilazarou *et al*., 2006). The results are in agreement with this notion.

Conjugated Dienes and Trienes (CD and CT): The contents of conjugated compounds formed could be detected by other physical and chemical methods, but changes in UV spectral properties have been considered as most powerful tool for this purpose (O'Connor, 1960). The changes in absorbance at 232 and 268 nm can be used as relative measures of oxidation (Che Man *et al*., 1999). The control CD and CT values for the control sample were 0.745+0.11 and 0.652+0.1, respectively. The highest values for CD (3.237+0.02) and CT (2.13+0.052) were obtained after 10h of kebab frying. The change in the conjugated dienes and trienes are shown in the Table 1, Fig. 4 and 6. The results show a strong relationship (r = 0.9316) between the CD and frying time.

Trienes and Diene-conjugated peroxides show a maximum absorbance at 230-232 nm. Conjugated ketodienes, dienals and trienes show maximum absorbance at 268-270 nm. Oxidation of polyunsaturated fatty acids is accompanied by increased ultraviolet absorption (O'Brien, 1998). The data indicated that most oils and their blends experience an increase after successive frying and greater changes occurred in trienes compared to dienes (Susheelamma *et al*., 2002). These observations are in accordance with the results obtained by El-Sayed and Allam (2003), which fried the potatoes for 20 h at the rate of 5 h/4 days and concluded that the longer the frying time, the higher was the absorbance for the conjugated trienes in the oil. The presence of food antioxidants may however affect this process. The trend for conjugated trienes was similar to that seen for Anisidine Value. The result indicates the formation of CT and CD during the 10 h of kebab frying.

POV: The relationship between POV and frying time is shown in Fig. 2. The POV of the control was 4.37±2.474 which increased with the frying time and maximum value (28.37±13.05) was observed after 10 h of frying. Strong relationship (r = 0.952) between the POV and frying time as shown in Table 2. It shows the significant increase in the POV of the tallow by frying kebab for the 10 h. Chatzilazarou *et al*. (2006) showed a significant increase in olive oil POV after 10 h of frying, while in the corn oil, a significant change occurred after only 8 h of frying, which are an agreement with the results is obtained in this study. The significant increase in the POV propose that POV can be adopted as the standard factor in the evaluation of oxidation of tallow used for the frying kebab and the upper limit at the commercial level will be determined as 29 meq/kg.

FFA and acid value: The changes in the % FFA and Acid Values are shown in Table 1 and Fig. 6. The FFA of the control tallow was 0.530+0.34, while the acid value was 1.0547+0.69. It shows a slight but not significant overall increase in the FFA and Acid value in the tallow during frying kebab for the last 10 h. The increase in FFA could be attributed to oxidation and hydrolysis, which produces FFAs (Peeled *et al*., 1975; Abdel-Aal and Karara, 1986). Moreover, FFA content is a dynamic value because at the

Table 1: Effect of frying kebab on the physicochemical parameter of tallow

Parameter	0 h frying (control)	After 2 h frying	After 4 h frying	After 6 h frying	After 8 h frying	After 10 h frying
Ash (%)	0.376±0.27	0.461±0.01	0.53±0.06	0.591±0.09	0.76±0.22	0.828±0.345
POV (meq/kg)	4.37±2.47	15.56±0.9	19.37±1.0	23.72±3.5	26.56±2.3	28.37±13.05
OD (absorbance at 420nm)	0.519±0.24	0.923±0.021	1.22±0.019	1.49±0.036	2.531±0.011	3.237±0.02
CD (absorbance at 232nm)	0.745±0.11	1.247±0.005	1.528±0.007	1.701±0.002	2.05±0.006	2.13±0.052
CT (absorbance at 270nm)	0.652±0.1	0.915±0.050	1.96±0.012	1.649±0.137	1.84±0.122	2.047±0.21
FFA (as % oleic acid)	0.530±0.34	0.948±0.056	0.675±0.028	0.586±0.042	0.691±0.070	0.891±0.48
Acid Value	1.0547±0.69	1.886±0.141	1.343±0.051	1.166±0.042	1.375±0.028	1.710±0.90
An-V	7.95±2.29	50.55±1.23	86.50±2.41	119.64±4.28	127.21±6.23	131.30±8.36

*Mean±SD

Table 2: Linear regression data of different parameters of the animal tallow

	Tallow A	
Parameter	Linear Equation	R*±
% ash±	Y = 0.060+0.3611	0.988
Peroxide Value	Y = 2.2479x+8.419	0.952
Optical Density	Y = 0.2668x+0.32	0.979
Conjugated Dienes	Y = 0.1358x+0.8878	0.9316
Conjugated Trienes	Y = 0.1348x+0.8363	0.863
Free Fatty Acid	Y = 0.0135x+0.6527	0.304
Anisidine Value	Y = 12.5696x+24.343	0.955

*Correlation Coefficient

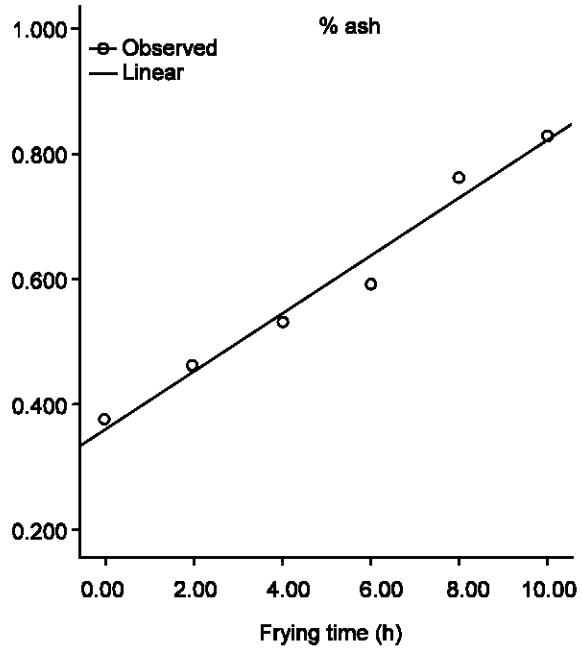

Fig. 1: Effect of frying on the % ash value of the tallow

same time that the acids are being produced, they have sufficient vapor pressure at frying temperatures to evaporate from the surface (Peeled *et al*., 1975). The acid values may not be quantitatively related to the acidic products formed during oil deterioration as FFAs may be lost through volatilization at the high temperatures of frying. Loss of acidic products may also occur due to the neutralization effect of food being fried (Che Man *et al*.,

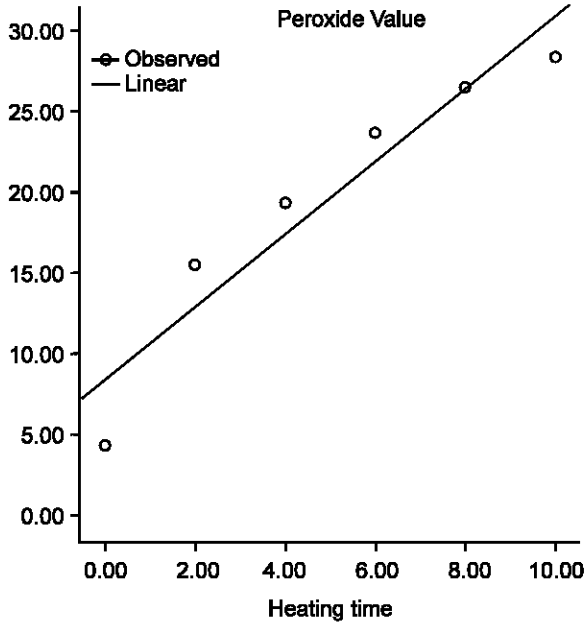

Fig. 2: Effect of frying on the peroxide value of the tallow

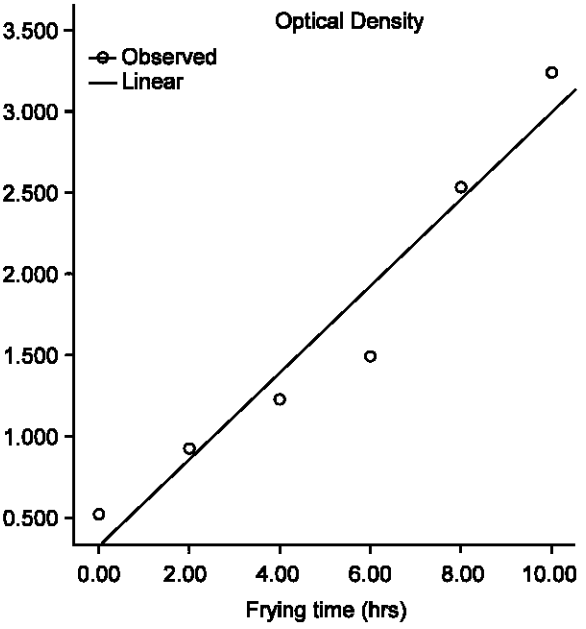

Fig. 3: Effect of frying on the optical density of the tallow

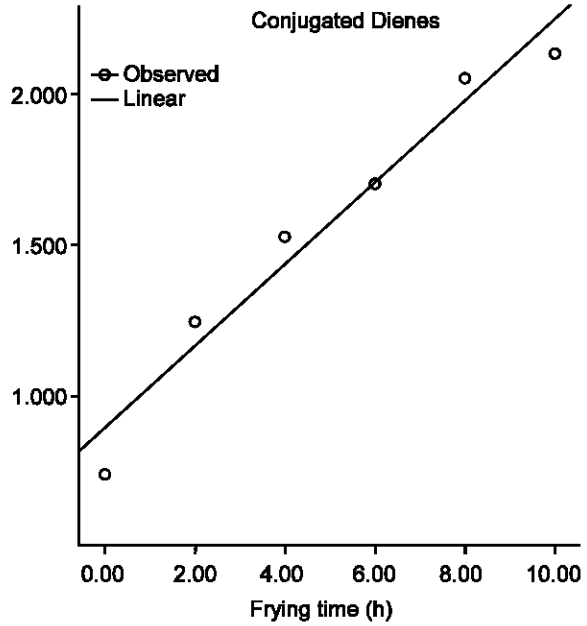

Fig. 4: Effect of frying on the conjugated dienes of the tallow

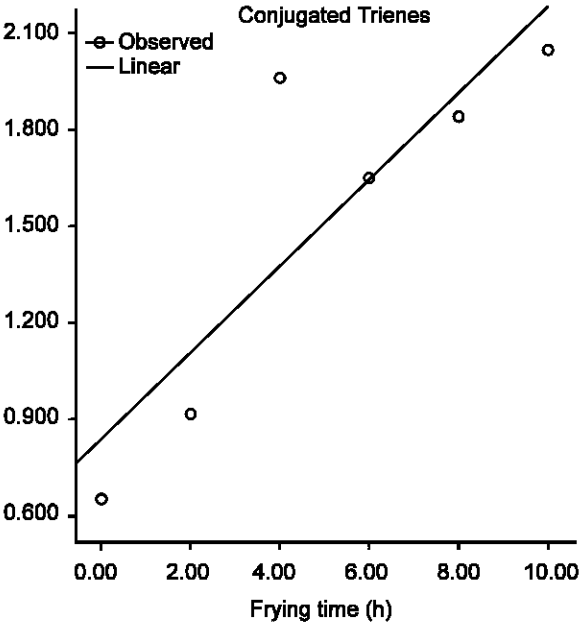

Fig. 5: Effect of frying on the conjugated trienes of the tallow

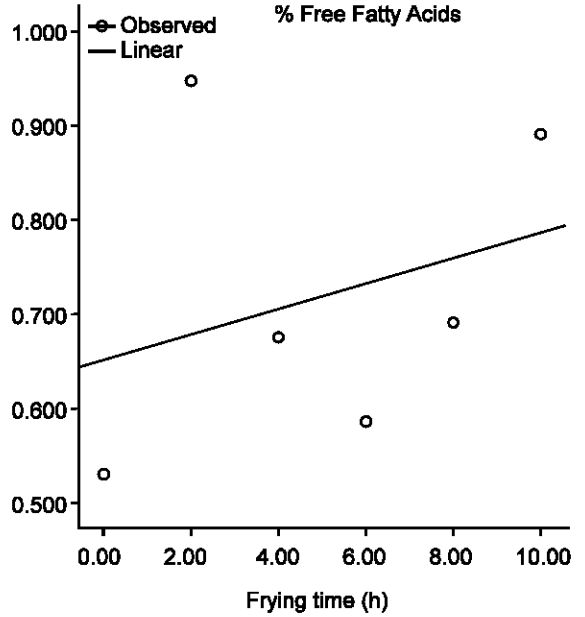

Fig. 6: Effect of frying on the % free fatty acids of the tallow

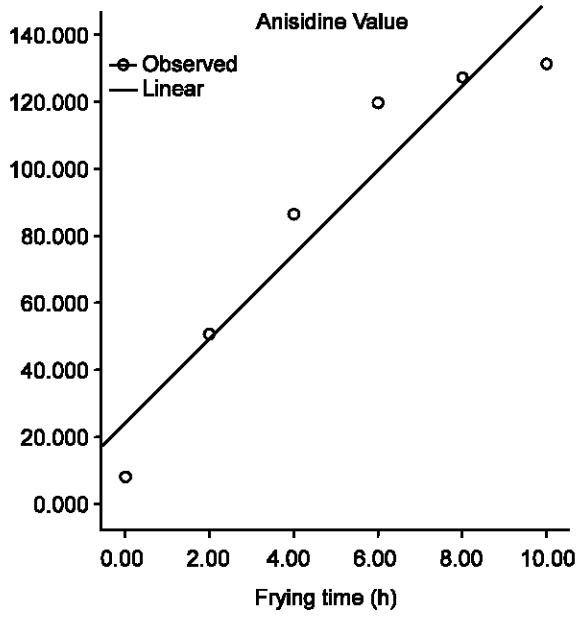

Fig. 7: Effect of frying on the anisidine value of the tallow

1999). Chatzilazarou *et al*. (2006) found a slight but not significant effect on the FFA level of the olive and corn oils upon frying potato and cod which is in accordance with the results obtained in this study. Results of the present study shows that the FFA level for tallow used in kebab frying was in the range of 0.530-0.948%.

% Ash value: The ash value (%) of the control tallow was 0.376±0.27 which is the lowest. The highest ash value (0.828+0.345) was observed after 10 h of frying. It shows a slight increase in the ash value of the tallow during the kebab frying. The ash Value measures the ash forming compounds which should as low as possible for the production biodiesel from the tallow because they contribute to the injector deposits or fuel system fouling (US Department of Energy, 2006). The ash Value of all

the samples was <1% which indicates that it can be used for the production of biodiesel. For this purpose the used tallow can be processed for the production of the biodiesel.

Conclusion: Results of the present study suggest that frying kebab have significant effect on the physicochemical characteristics of the tallow and continuous frying for more than 10 h cause significant increase in physicochemical characteristics which shows deleterious effects of frying on quality of the tallow. It is also proposed that POV can be adopted as the standard factor in the evaluation of oxidation of tallow used for the frying kebab and the upper limit will be determined as 28 meq/kg. As the oxidized fats are toxic hence the suppressing the formation of oxidized compounds in the tallow during frying is also an important matter in terms of toxicity.

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