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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

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Mineral Composition, Quality and Physico-chemical Parameters of the Local Tallow of Pakistan

Muhammad Ali, Waqar Ali, Saeed Ahmed and Ikram Ullah
Department of Biotechnology, University of Malakand, Chakdara, Dir Lower, NWFP, Pakistan

Abstract: Tallow samples were obtained form the local slaughterhouses and were evaluated for iodine value, saponification value, anisidine value, acid value, peroxide value, FFA, ash content and cholesterol content. The results were compared with that of Codex standard for the edible animal fats. The acid value of tallow was 1.009-1.99 mg KOH/g. The saponification value (195-197 mg KOH/g) indicate that the tallow contain high molecular weight fatty acids. The iodine values (48.66-49.15) suggest a low degree of unsaturation compared to palm oil. The FFA, AnV and POV were 0.507-1.00 (as oleic acid %by wt.), 6.33- 9.57 and 3-6.5 (meq / kg) respectively. The cholesterol and %ash content were in the range of 1.00-1.10 (mg/g) and 0.183-0.57, respectively. In minerals, the level of Na is 10.037-18.952 ppm, K (2.216-2.821 ppm), Ca (1.123-1.752 ppm), Cu (0.001 ppm), Fe (0.430-0.493 ppm), Pb (1.147-1.153 ppm), Mg (0.412-0.473 ppm), Cd (0.070-0.071 ppm), Zn (0.028-0.055 ppm) and Cr (0.896-0.982 ppm).

Key words: Animal tallow, quality and physico-chemical parameters, minerals

Introduction

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 (Brooke, 1985; Zeb and Ali, 2008). A number of characteristics of tallow are of importance to determine the quality of food and feed. A low percentage of free fatty acids (FFA) in combination with a low peroxide value (POV) can elucidate as a fresh product. The peroxide value is a size for the oxidation of fatty acids. In addition, moisture and insoluble impurities (II) should be as low as possible in animal fats. Typically freshly melted edible animal fats have the following commercial specification; FFA < 0.50%, POV < 4%, moisture < 0.20% and II < 0.02% (typical value < 0.01%, not detectable) (Woodgate and van der Veen, 2004). Tallow is statistically one of the most important animal fats, which is extracted from animal tissues containing fat by a variety of processes called rendering or melting. Tallow is used in a broad range of applications from shortenings, frying fats and margarine to animal and pet feeds and in the manufacture of oleo-chemical products for a very wide variety of applications including food, feed, cosmetics, medicinal and pharmaceutical products (The European Oleochemicals and Allied Products Group, 2003). Traditionally, rendering was a simple heating process that allows melted tallow to be separated from animal tissues so that it could be used for a variety of purposes. Now-a-days, there is a sector for rendering that process only the large deposits of discrete adipose tissues that can be obtained from animals declared fit for human consumption. These renders (known more specifically as fat melters) produce high-quality tallow that is considered to be safe for human consumption, if the adipose tissues has been sourced from animals declared fit for human consumption (Taylor and Woodgate, 2003).

Moreover, Food composition data is important in nutritional planning and provides data for epidemiological studies (Bruce and Bergstrom, 1983). Trace metals composition of foods is of interest because of their essential or toxic nature (Onianwa *et al*., 1999). The presence of small amounts of trace metals in oils and fats is known to produce deleterious effects on quality. The strongest and most notable pro-oxidants are copper and iron, which produce a noticeable oxidative effect at concentrations as low as 0.005 and 0.03 ppm respectively (Marfec and Bulinski, 1997; Persmers and Toregrand, 1971). Micronutrients play very important roles in different metabolic processes and their excess or deficiency may disturb normal biochemical function of the body (Akhter *et al*., 2002). In Pakistan, tallow is mostly rendered at the slaughterhouse using the conventional methods that has been used for the centuries. This rendered fat is then used widely for the edible and frying purposes especially in frying kebab, which is one of the mostly available traditional fast food of the Pakistan. There is no information on the mineral composition, quality parameters and physicochemical characteristics of the tallow rendered at the local slaughterhouses. The aim of this study was to evaluate the tallow rendered at the local slaughterhouses for the mineral and physicochemical parameters and compare it with the international quality standards.

Materials and Methods

Two different samples of the tallow were collected from the local slaughterhouses in Chakdara, NWFP,

Pakistan. Sample selections were made on the basis of difference in color of the fats. The tallow with pale yellow color was named "Tallow A", while the tallow with off-white color was named "Tallow B". All analytical reagents used for analysis were either from Merck (Darmstadt, Germany) or Sigma Aldrich (Buchs, Switzerland).

Physico-chemical parameters: Iodine value, Acid Value, % free fatty acids (%FFA), Anisidine value (An-V), peroxide and saponification values of the local tallow were determined using standard AOCS methods (1997). The cholesterol content was determined by using UV-visible spectrophotometer as described by Sabir *et al.*, (2003). Moisture content (%) was determined by using methods as described by the IUPAC (1979). Ash value was determined by using muffle furnace. For this purpose organic matter was destroyed by heating completely charred tallow sample at 600°C for 2 hrs in muffle furnace and present ash was determined as:

$$\text{Ash value (\%)} = \frac{m_2 - m_1 \times 100}{m_3 - m_1}$$

Where,
m_1= weight of the china dish
m_2= weight of the china dish + Tallow
m_3= weight of the china dish + ash

Mineral Composition: The mineral composition (Na^+ and K^+) was determined with the help of flame photometer (Jenway PFP7) by the method describe recently (Khan and Zeb, 2007). Heavy metals like Ca, Cu, Fe, Pb, Mg, Cd, Zn and Cr were determined with help of Atomic Adsorption Spectrometer (Perkin Elmer, model Analyst 700) with air/acetylene flame at 2200-2400K (photo multiplier tube detector), against the standard (Hanlon, 1992).
All the parameters were determined at least in triplicate and the results were presented in mean ± standard deviation (SD).

Results and Discussion

Moisture and volatile matter: The moisture and volatile matter at 105°C is 0.223-0.226 percent and according to the Codex Standards, 1999 the maximum level of volatile matter at 105°C is 0.3% (CODEX-STAN-211, 1999). Nawaz *et al.* (2003) has also reported 0.34 percent moisture level in the tallow, which is in agreement with our results.

Acid value and % free fatty acid (FFA): Acid Value was 1.009-1.99, while the FFA expressed as % oleic acids was 0.507-1.00. The increase in FFA could be attributed to oxidation and hydrolysis, which produces FFAs (Peeled *et al.*, 1975; Abdel-Aal and Karara, 1986).

Table 1: Physicochemical parameters of the local tallow

Parameter	Tallow A	Tallow B
Ash value (%)	0.57±0.021	0.183±0.014
%Moisture	0.266±0.001	0.233±0.007
POV(meq active oxygen/ kg)	3±0.5	6.5±0.2
FFA (as oleic acid %by wt.)	0.507±0.056	1.00±0.052
Acid Value(mg KOH/g fat)	1.009±0.112	1.99±0.078
An-V	9.57±0.05	6.33±0.51
Cholesterol (mg/g)	1.1±0.2	1.00±0.7
Saponifiation Value(mg KOH/g fat)	195±3.54	197±4.47
Iodine Value(Wijs)	48.66±2.66	49.15±2.1

*Mean±standard deviation.

According to the regulations of the CODEX standard for named animal fats (CODEX-STAN-211, 1999), edible Tallow should have their maximum acid values 2.5 mg KOH/g of fat = FFA max 1.25 %.

Anisidine value (AnV): Anisidine value is one of the methods used to quantify secondary oxidation products of oil by measuring the aldehydes, principally 2, 4-dienals (Augustine and Chong, 1986). Anisidine value measures 2-alkenals, hydroperoxide decomposition products that can be used to determine how much per-oxidized material has already broken down (Brewer *et al.*, 1999). The anisidine value ranges from 6.33 to 9.57 as given in table 1. The samples of the tallow have the An-V less than 10 which reflect its good quality.

Peroxide value (POV): The POV of the samples is 3-6.5 meq/kg. According to the regulations of the CODEX standard for named animal fats (CODEX-STAN 211 - 1999), edible tallow should have their POV up to 10 meq/kg fat. The results of the tallow A and B are in agreement with this notion.

Saponification value: The saponification value for tallow A and B was 195±3.54 and 197±4.47 respectively. The saponification value is directly related to the mean molecular mass (Yanty *et al.*, 2008). The saponification values are less than that of palm oil. The low saponification value indicates that the tallow have larger molecular weight than the common oils. This may be due to the presence of higher saturated fatty acids. The low saponification value suggests that the oils can be used for candle and soap production and as chemical feed stocks for lubricants (Agatemor, 2006). The saponification value of the tallow is in agreement to the Codex (1999). The saponification value of the tallow (195-197 mg KOH/g) was also similar for those reported in the literature for cottonseed oil (189-198 mg KOH/g), but lower than those for coconut oil (248-265mg KOH/g) (Codex Alimentarius Commission, 1982).

Iodine value: The iodine value for the tallow A, B was 48.66±2.66 and 49.15 respectively. The iodine value is the measure of the degree of unsaturation of fat (Yanty *et al.*, 2008). The iodine value is also an index for

Table 2: Mineral composition of the Tallow A and B (all the concentrations are shown in ppm)

Element	Tallow A (ppm)	Tallow B (ppm)
Sodium	18.952±1.325	10.037±1.213
Potassium	2.216±0.397	2.821±0.351
Calcium	1.123±0.664	1.752±0.0024
Copper	0.001±0.0006	0.001±0.0001
Iron	0.493±0.0120	0.430±0.0096
Lead	1.153±0.0194	1.147±0.0152
Magnesium	0.412±0.0051	0.473±0.0055
Cadmium	0.070±0.0003	0.071±0.0004
Zinc	0.028±0.0016	0.055±0.0021
Chromium	0.982±0.0223	0.896±0.0138

*Mean±standard deviation

assessing the ability of oil to become rancid (Eka, 1980; Amoo *et al.*, 2004). The tallow has a low iodine value compared with palm oil (Which is 56.10 according to Agatemor, 2006). The low iodine value indicates that the tallow has a low content of unsaturated fatty acids relative to palm oil. The Wijis iodine value is also in accordance to the Codex (1999), which shows its good quality.

Cholesterol content (mg/g): The cholesterol content of the tallow ranges from 1.1±0.2 to 1.00±0.7 (mg/g). These results are in agreement with Sabir *et al.* (2003) who determined the cholesterol in beef tallow to be 1 mg/g. Among the samples of butter and Haleeb Desi ghee contained the high amount of cholesterol, while milk fat, beef tallow and fish fat were low in cholesterol content. Beef fat is poor source of cholesterol but it contains Myristic acid, which leads to cholesterol in blood (Sabir *et al.*, 2003).

Ash value (%): The % ash (0.183-0.57) value of the tallow rendered at the local slaughterhouses is <1%, which indicates that it is best for the production of the biodiesel. Using animal fat as fuel could help to solve the problem of waste disposal (Wiltsee, 1998).

Mineral composition: The results regarding elemental composition is shown in Table 2. The analysis of the mineral composition showed the level of Na (10.037-18.952 ppm), K (2.216-2.821 ppm), Ca (1.123-1.752 ppm), Cu (0.001 ppm), Fe (0.430-0.493 ppm), Pb (1.147-1.153 ppm), Mg (0.412-0.473 ppm), Cd (0.070-0.071 ppm), Zn (0.028-0.055 ppm) and Cr (0.896- 0.982 ppm). The CODEX standard (CODEX-STAN 211 - 1999) shows the maximum permissible concentration for Lead (0.1mg/kg), Iron (1.5 mg/kg) and copper (0.4 mg/kg). The table clearly shows that the concentration of copper and Iron is below the maximum permissible concentration while that of the Lead is very high as compared with the codex standards. The contamination of pro-oxidants and toxic metals in such products may be kept to a minimum level, with proper treatment and handling of oils and fats e.g., pretreatment with phosphoric acid and effective purification during refining and bleaching, citric acid treatment after deodorization and fine filtration after post treatments etc. (Anwar *et al.*, 2004). High levels of metals in the controlled tallow may be due in part to poor operating and maintenance conditions in our industries.

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