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Analytical Evaluation of Fatty Residues of *Capra hircus* and their Utilization in Global Food Industries

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Abstract

The present work utilizes the traditional methods for extracting, purifying, and estimating fat samples from *Capra hircus*. Through the Soxhlet method extracted, the animal fat sample and a rotatory evaporator were used to refine it. The purified sample was analyzed with the help of an FT-IR spectroscopic device and detected the different functional groups. These functional groups represented saturated and unsaturated fatty acids. Different parameters evaluated the analytical properties of the fat sample. It observed that the fats of *Capra hircus* consist of pH value 6.7, melting point 36-56ºC, refractive index 1.448 -1.460, specific gravity 0.90, density 0.85-0.90, iodine value 55-60 I2/100gm, and the smoke point is 0.2% at 210ºC respectively. Finally, we concluded that the fat of *Capra hircus* in different food products, including ice cream, chocolate, cheese, pastries, chewing gums, potato chips, and hard candy, will be commonly utilized.

***Key words*:** Soxhlet, Purification, Edible fat, FT-IR

The meat industry in India plays a significant role in providing a source of revenue to rural people in the country. Animal Slaughtering provides meat and offers valuable byproducts for humanity. Efficient utilization of byproducts directly impacts the economy and environmental pollution of the country [1]. China is the top country in the number of slaughtered cattle and buffaloes for meat globally. As of 2020, the number of slaughtered cattle and buffaloes for beef in China was 46,650 thousand heads, accounting for 22.56% of the number of slaughtered buffaloes and cattle for meat. The top five countries (Brazil, India, the United States of America, and Argentina) account for 81.84%. The total number of slaughtered buffaloes and cattle for meat at 206,754 thousand heads in 2020 [2].

Most of the food animals would eventually use for food purposes. Such animals play a crucial role in the food production chain in which pathological data, information on the presence of pathogens, drug residues, antimicrobial resistance and chemical contaminants. Therefore, Slaughterhouses represent an essential control point for the early identification of potentially catastrophic problems that may impact public health and animal health and welfare. There are different types of fat content obtained from slaughtered animals; it includes leaf fat, caul fat, pork fat, chicken fat, etc. [3]. Animal fats are an essential byproduct of slaughterhouses. The fatty residues are commonly used to produce different products globally in the food industry. There are edible and inedible fats that are utilized in various products. The European Union categorized the inedible fat into three different risk categories, including Used Cooking Oil (UCO), Yellow Grease (YG) and Brown Grease (BG). The edible fats are produced from fresh slaughter byproducts that were declared fit for human consumption. Typical edible fats are beef tallow, pork lard, goose, or duck fat.

MATERIALS AND METHODS

Extraction of fatty residues from sample

The 250 gm fatty residues of *Capra hircus* were brought locally in the meat shop. The sample was collected from Mulund and identified in the Department of Zoology, KET's V.G. Vaze College of Arts, Science and Commerce (Autonomous), Mulund (E), Mumbai-81. The collected samples were washed and stored in the refrigerator at 4°C. Take the collected sample to extract fat [4]. The 250 gm sample was placed in a porous thimble for the fat extraction at different intervals in the Soxhlet apparatus. After that, add 200 ml of alcohol in 500 ml to a round bottom flask of the Soxhlet apparatus [5]. A total of six hours for the extraction of the sample were required.

Purification of extracted fats

Extract the samples into two different forms, including the fat and solvent, separated through a rotary evaporator [6]. Collect the fat sample and solvent in two different bottles and keep them in the laboratory. Finally, the mass of the fat sample remains was measured and preceded the analysis.

Analysis of fatty residues by FT-IR spectrophotometer

The extracted fat sample was analyzed with the help of Fourier Transform Infrared Spectroscopy (FTIR) spectroscopic techniques. The different graphical peak values were compared with the help of standard values.

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Evaluation of properties of fatty residues

pH value analysis

Two-gram sample were poured into 50 ml of a glass beaker, and then 12 ml of hot distilled water was added in the sample and stimulated slowly. The mixture was then allowed to cool in a cold-water bath for up to 250. The pH meter was standardized with buffer solution and then inserted into the sample, and pH values were measured [7].

Melting point

The melting point (M.P.) of a solid is the temperature at which it changes state from solid to liquid. The melting point of the fat sample is 360°C-560°C.

Refractive index

A Few drops of fat samples were moved to a glass slide of the refractometer, and observed the dark portion. Again, it was adjusted to be in line with the intersection of the cross. In this case, the pointer on the scale pointed to the refractive index and values were recorded [8].

Specific gravity

Specific gravity is measured by dividing the density of a fat sample by the density of water at 4°C.

Density

However, when the fats melted, their volume increased, and the density increased. Use the standard method to measure fat density.

Iodine value

It indicates the degree of unsaturation; it means the number of double bonds present at the length of the chain. The iodine value is low for animal fats. The Higher the iodine value, the melting point becomes lower. The higher the iodine value, the lower becomes the melting point. So, the iodine value was calculated as 55-60 I2/100 gm of extracted fat.

Smoke point

The smoke point means the burning point, the temperature at which the fat begins to produce a continuous bluish smoke that becomes visible, dependent upon specific and defined conditions. For example, the smoke point of extracted fats was 0.2% at 210ºC.

RESULTS AND DISCUSSION

Characterization of the fat sample of Capra hircus by FT-IR spectroscopy

Fatty acids are essential components of lipids in living organisms, including plants, animals, and different microorganisms. Therefore, the extracted fatty residues were analysed with the help of the FT-IR spectroscopic method (Fig 1). The Fourier Transform Infrared Spectroscopy (FTIR) can mainly represent the information on lipid structure and functional group [9]. The spectra of the fat content of *Capra hircus* in (Fig 1) were recorded at different wavelengths. The many functional groups were recorded in FT-IR spectra of Fatty residues of *Capra hircus*. It includes 3552.28 cm^{-1}, 2974.23 cm^{-1}, 2927.94 cm^{-1}, 12895.15 cm^{-1}, 1647.21 cm^{-1}, 1381.03 cm^{-1}, 1350.17 cm^{-1}, 1327.03 cm^{-1}, 1274.95 cm^{-1}, 1085.92 cm^{-1} and 879.54 to 439.77 cm^{-1} respectively. The wavelength 3552.28 cm^{-1} represents the strong peak of the functional group Carboxylic acid OH stretch. The range of peak values 3552.28 to 2974.23 cm^{-1} was recognized as –C=CH (Cis double bond stretching) can be correlated with monounsaturated fatty acid (MUFA) [10]. The 2974.23- 2927.94 cm^{-1} and 2895.15 cm^{-1} wavelengths represented the –C-H Stretch and –C-H aldehydic functional groups, respectively (Table 1). The sample recorded the weak peak; it includes 1647.21 cm^{-1}, 1381.03 cm^{-1}, 1350.17 cm^{-1}, 1327.03 cm^{-1} and 1274.95 cm^{-1} representing the functional groups; for example, C=C alkene, CH_3 bend, C-O-C stretch and NO_2 Stretch [11].

Quality analysis of fats of Capra hircus

The analytical properties of the fat sample of *Capra hircus* were estimated separately and recorded in the readings. Therefore, the analytical properties of the fats of *Capra hircus* were mentioned in (Table 1). The properties of fats were estimated under different parameters, including the pH value of 6.7, melting point 36-56°C, refractive index 1.448 -1.460, specific gravity 0.90, density 0.85-0.90, iodine value 55-60 I2/100gm, and the smoke point is 0.2% at 210°C recorded respectively (Table 1).

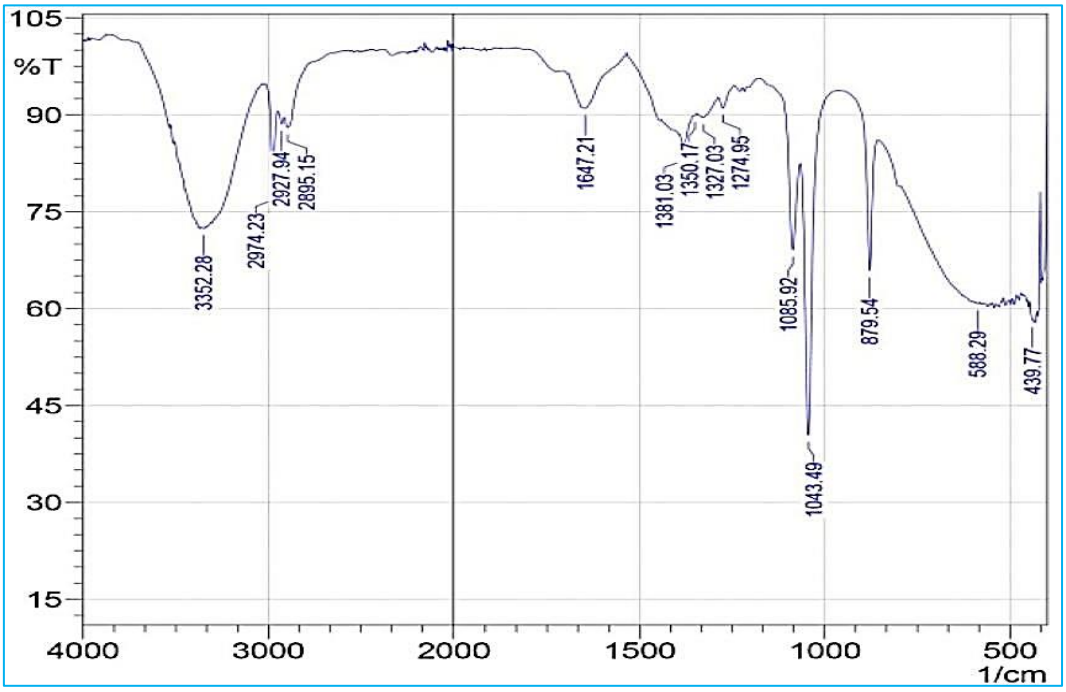

Fig 1 FT- IR spectra of fat sample of *Capra hircus*

Table 1 Quality analysis of fats of *Capra hircus*

Parameters	Identified values of animal fats
pH value	6.70
Melting point	36- 56^{0}C
Refractive index	1.448 -1.460
Specific gravity	0.90
Density	0.85 – 0.90
Iodine value	55-60 I_2/100gm
Smoke point	0.2% at 210°C

Utilization of animal fats in *global food industries*

Animal fats produce margarine, shortening and compound fats and are utilized in processed food products globally. The animals are slaughtered in a slaughterhouse to produce their byproducts for human welfare. Animal fat is a good source of food, and it is a good source of vitamin A, D & E [12]. Global industries produce seven essential food products by using animal fats. Ice cream is the one crucial food that temporarily heals all wounds. The animal fats contain cupric acid that is present in ice cream (Table 2).

The emulsifiers are present in chocolate and obtained from animal fats. Animal rennet is essential in the production of many different kinds of cheese. The lard is utilized to make pastries and is rendered fat from a pig's abdomen or kidneys. It also contains capric acid. The potato chips make by using fat from the membranous tissue of cattle. Pork fats make the chewing gum. Hard candy is one of the essential products containing calcium stearate obtained from animal fats. So, animal fat contents play a crucial role in making different food products, which are beneficial and valuable to human welfare.

Table 2 Utilization of animal fats in food products

Food products	Animal fat type
Ice cream	Chicken, Cattle and buffalo fats.
Chocolate	Pork, sheep fats
Cheese	Pork, Cattle fats
Pastries	Pork fats
Chewing Gum	Pork, Cattle and buffalo fats
Potato Chips	Cattle and buffalo fats
Hard Candy	Chicken, Pork, Cattle and buffalo fats

CONCLUSION

The fat of *Capra hircus* is a highly beneficial product obtained from slaughterhouse waste. Animal fats are an essential source of unsaturated and saturated fatty acids. These fats were extracted with the Soxhlet method and purified with a rotator evaporator. FT-IR Spectroscopy is one of the most reliable methods for analyzing fatty acids. Furthermore, the analytical evaluation of the fat sample shows the same value as the standard fat sample value. Finally, we concluded that the fat of *Capra hircus* in different food products, including ice cream, chocolate, cheese, pastries, chewing gums, potato chips, and hard candy, will be commonly utilized.

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