Journal of Animal Research: v.13 n.05, p. 753-761. October 2023

DOI: 10.30954/2277-940X.05.2023.17

Development of Utility Pet Soap Utilizing Rendered Fat from Deserted Poultry Sleeves

Mukesh Gangwar[1*], Rajiv Ranjan Kumar[2], S.K. Mendiratta[3], Ashim Kumar Biswas[3] and Sagar Chand[3]

[1]Department of Livestock Products Technology, College of Veterinary and Animal Sciences, BASU, Kishanganj, Bihar, INDIA
[2]Division of Livestock Products Technology, ICAR-CIRC, Meerut, U.P. INDIA
[3]Division of Livestock Products Technology, ICAR-IVRI, Izatnagar, Bareilly, U.P. INDIA

**Corresponding author: M Gangwar; E-mail: mukeshkurmi32@gmail.com*

Received: 26 Aug., 2023 **Revised:** 25 Sept., 2023 **Accepted:** 29 Sept., 2023

ABSTRACT

High consumption of poultry meat in the country leads to a considerable amount of poultry sleeves (skin along with feathers) as waste, which causes serious environmental problems and loss of valuable nutrients. Skin is one of the most underutilized poultry byproducts and a good source of quality fat. The present study was done to prepare pet soap utilizing rendered poultry skin fat from deserted poultry sleeves. Chicken skin fat (CSF) was obtained from de-feathered poultry skin by dry rendering (70°C, 2 h); wet rendering (70°C, 2 h) and microwave rendering (low microwave power for 6 min). The rendered poultry skin fat was then utilized for preparation of pet soap. The sodium hydroxide requirement for preparation of pet soap was standardized and the process for its preparation was optimized based on BIS standards. There was no significant difference ($P>0.05$) in the Yield, pH, Free alkali content, Total alkali content and Foam stability of soap prepared from CSF extracted by dry, wet or microwave rendering. However, the Leathering/washing power, Cleansing power and Total fatty matter (TFM) content were significantly higher ($P<0.05$) in soap prepared from microwave rendered fat. In addition, Free fatty acid value, Peroxide value and MDA value were significantly higher ($P<0.05$) in wet rendered than dry or microwave rendered fat soap. Hence, the rendered poultry skin fat could be a good base material for preparation of utility pet soap and microwave rendered CSF produce best quality soap.

HIGHLIGHTS

- Poultry sleeves important by-products of poultry industry.
- With the help of different rendering regimes poultry fat extract from poultry skin
- Pet soap preparation with the use rendered poultry fat good option to reduce environmental pollution

Keywords: Rendered fat, Soap, Poultry skin, Rendering, Total fatty matter

The poultry sector has been expanding quickly in order to maintain a steady supply of meat and eggs and a huge number of poultry birds are slaughtered each year for this purpose. It leads to the generation of enormous quantity of poultry slaughter waste that includes bones, viscera, belly fat, feet, heads, blood, and feathers. These by-products could be used to make biodiesel, animal feed, and pet food (Abid and Touzani, 2017; Vikman *et al*., 2017). Poultry sleeves (skin and feathers), which are typically dumped on the ground after roadside poultry slaughter, pose a significant environmental risk. Under-utilization of poultry skin results in loss of potential income, increases the cost of disposal, and can lead to serious aesthetic problems as well as detrimental health conditions. The one way to reduce environmental pollution and generate income is to use chicken sleeves for the extraction of high-quality fat by rendering (Ogbuewu *et al*., 2012). Rendering is the process by which animal waste is transformed into useful

How to cite this article: Gangwar, M., Kumar, R.R., Mendiratta, S.K. Biswas, A.K. and Chand, S. (2023). Development of Utility Pet Soap Utilizing Rendered Fat from Deserted Poultry Sleeves. *J. Anim. Res.*, **13**(05): 753-761.

Source of Support: None; **Conflict of Interest:** None

materials like rendered fat and leftover proteinaceous material could be used for preparation of animal feed or for other purposes. Therefore, considering the enormous amount of chicken sleeves produced in India, there is a need to find alternate uses of the rendered chicken skin fat.

Soap is a cleaning product produced as granules, bars, flakes, or liquid and is made by reacting salts of sodium or potassium with a variety of fatty acids that are derived from natural sources. Soaps are made for different purposes, such as cleansing, bathing, and administering medication. Sodium and potassium are two metals that are frequently utilized to create soaps that are water-soluble (Roila *et al*., 2001). The process of generating soap (saponification) involves the hydrolysis of triglycerides by a base (often NaOH or KOH) to produce soap and glycerol. The nature and strength of the alkali, as well as the kind and saponification value of the oil used to prepare soap, are a few variables that affect the physicochemical characteristics of soap. The rendered poultry skin fat could be an economical base material for preparation of pet soap. The fatty acid composition of the oil or fat used to prepare soap affects its properties to a great extent and rendering techniques (dry, wet or microwave) used to extract chicken skin fat changes the fatty acid composition of rendered fat (Gangwar, 2019). Therefore, the present study was conducted to develop and compare the utility pet soap prepared utilizing wet, dry and microwave rendered poultry skin fat from deserted poultry sleeves.

MATERIALS AND METHODS

Chemicals

The chemicals and reagents of analytical grade were used in experimentation and procured from Hi-media Laboratories (P) Ltd. (Mumbai, Maharashtra, India), CDH (New Delhi, India) and Sisco Research Private Ltd. (Mumbai, Maharashtra, India).

Preparation of soap

Rendered chicken skin fat (CSF) was obtained from de-feathered poultry skin by dry rendering (70 °C, 2 h); wet rendering (70 °C, 2 h); and microwave rendering (low microwave power for 6 min). The rendered CSF was utilized for the preparation of utility pet soap. The samples of soap were prepared using cold saponification from three different rendered fats [Dry rendered fat (DRF), Wet rendered fat (WRF) and Microwave rendered fat (MRF)]. The chicken skin fat was melted down and poured into a beaker, and then this beaker was kept on a hot magnetic stirrer. The NaOH was dissolved in water and allowed to cool down to room temperature before blending with CSF (3–5 min). Heat was produced throughout the mixing procedure; however, it didn't increase over 45°C. After 24 hr. the mixture was removed and placed on filter paper to mature in the air before pouring into the silicon moulds. Samples were analyzed after four weeks once they were matured.

Evaluation of physiochemical properties of developed utility pet soap

The physiochemical properties of the developed pet soap were analyzed using standard procedures described by Vivian *et al.* (2014). The parameters measured were moisture content, pH, yield, total alkali content, free alkali content, total fatty matter (TFM), matter insoluble in water and percentage chlorides. Moreover, washing properties, cleansing properties, and foam stability of developed soap were evaluated as per the procedure suggested by Owoicho (2021).

pH of soap

Two gram of soap diluted in 10 mL of distilled water to determine the pH using a digital pH meter (Eutech Instruments Pvt. Ltd. Singapore).

Moisture content

In dried moisture dishes, 5 g of soap samples was taken. For approximately 6 hours, samples were dried at 105°C in a hot air oven to achieve a consistent sample mass.

$$\text{Percentage moisture} = \frac{\text{Weight of sample} - \text{Weight of dried sample}}{\text{Weight of sample}} \times 100$$

Total alkali content

To 10 g of soap sample, 100 mL neutralized ethanol and 5 mL 1N H_2SO_4 solution were added. The soap mixture

was heated until complete dissolution and titrated with 1N NaOH using phenolphthalein indicator. The following formula was used to calculate the total alkali.

$$\% \text{ Total alkali} = \frac{Va - Vb}{\text{Weight of sample}} \times 3.1$$

Va- Volume of acid added in experiments

Vb- Volume of base at end point

Free Caustic Alkali

The free alkali content of soap samples was determined as per the procedure described by Vivian *et al*. (2019). Five gram of soap sample was dissolved in 30 mL ethanol followed by addition of 10 mL of 20 percent $BaCl_2$ and a few drops of phenolphthalein indicator. The resultant solution was titrated against 0.05 M H_2SO_4. Free Caustic Alkali (FCA) was calculated using the formula:

$$\text{FCA} = \frac{0.31}{W} \times VA$$

Where; VA = Volume of acid,

W = Weight of soap

Total fatty matter (TFM) content

Ten-gram soap sample was mixed with 150 mL of warm neutralized ethanol, and heated to dissolve soap. The solution was filtered using pre-weighed filter paper, and residues on filter paper were dried in oven at 110°C for one hour and weighed again. The TFM was obtained using following formula:

% Total fatty matter = 100 − (Moisture content + Matter insoluble in alcohol)/1.085

Determination of Insoluble Matter in Water

One-gram sample of soap was added to a 100 mL beaker with 10 mL of hot distilled water. The sample of soap was entirely dissolved before filtering through known-weight filter paper. The residue and filter paper were dried out and weighed. Water-insoluble material was calculated as:

$$\text{Matter insoluble in water} = \frac{W2 - W1}{W} \times 100$$

Where:

W1-Weight of dried filter paper

W2-Weight of dried filter paper + dried residue

W -Weight of the sample

Percentage of chloride

The procedure outlined by Onyegbado *et al*. (2002) was used to determine the percentage of chloride. To 100 mL of distilled water, 10 g of soap was added and heated to dissolve the sample. The resulting mixture was poured into a 250 mL volumetric flask, to which 20 mL of 15% ($Ca(NO_3)_2$) was added, and the mixture was agitated to completely dissolve the soap. Distilled water was added to make the solution reach the 250 mL mark. Methyl red was added to 100 mL of the filtrate after the solution has been filtered. The solution turned pink after titration with 10 N H_2SO_4. The resultant solution was titrated against 0.1 $AgNO_3$ using $K_2Cr_2O_7$ as an indicator until a brick red hue was produced. The percent chloride was calculated using the formula below.

Percentage chloride = Titer volume/weight of soap × 0.585

Washing Properties

A small amount of the dry soap was used to wash the hands using deionized water. The lathering properties and the "feel" of the soap were evaluated (very slippery, greasy, or about normal).

Cleaning Properties

A drop of used soybean oil was placed on two separate, thin strips of filter paper. One filter paper with an oil stain, was placed in the test tube containing 1% soap solution. Second strip was inserted into the water-only tube. Each tube was vigorously shaken while being careful to fully submerge the filter paper in the fluid. The filter paper was removed and washed with tap water after 2 minutes. Comparisons were made between the cleaning abilities of soap and water. For each of the prepared soap samples, this reaction was conducted.

Foam stability

In a clean glass measuring cylinder (250 mL), 2% of

the soap samples were made. After rapidly shaking the mixture for two minutes, the foam height was measured. The samples were left as such for an hour, the foam height was recalculated and percentage of foam stability was determined as:

$$\text{Foam stability (\%)} = \frac{\text{The final height of foam}}{\text{The initial height of foam}} \times 100$$

Peroxide value

The peroxide values of soap were determined by the AOCS (1995). Five gram of soap sample was weighed into a 250-ml Erlenmeyer flask, and then 30 ml of acetic acid-chloroform solution (3:2) and 0.5 ml of saturated potassium iodide solution were added. The flask was maintained at rest for 1 min, and after that, 30 ml of distilled water and 1 ml of a 1% indicative starch solution were added. Mixture was titrated with 0.01 N $Na_2S_2O_3$ standardized with potassium dichromate until the blue colour disappeared, resulting in white at the end point.

The results were expressed in meq/kg.

$$\text{Peroxide value} = \frac{S \times N \times 1000}{W}$$

W = Weight in gram of the sample

S = Volume in ml of 0.01N $Na_2S_2O_3$ used (blank corrected)

N = Normality of $Na_2S_2O_3$

Free fatty acid (FFA) value

FFA content of soap samples was determined by procedure mentioned by Sany and Fahmi (2019). Five gram of soap sample was taken in a 250 ml conical flask; 50 ml of 95% ethanol was added, followed by two drops of 1% phenolphthalein. This mixture was titrated by using a 0.1N KOH until the pink colour appeared. The free fatty acid (%) was calculated as follows:

$$\text{Free fatty acid as oleic acid} = \frac{28.2 \times V \times N}{W} \times 100$$

Where, V = Volume in mL of standard KOH used

N = Normality of the KOH solution

W = Weight of the sample in gram

MDA evaluation

Malondialdehyde (MDA) content was determined with some minor modifications from Khalifa *et al*. (2016). 1 mL of EDTA and 5 mL of a 0.8% BHT solution were added to a precisely measured 2 g soap sample and carefully mixed. After that, 6 mL of a 10-percent trichloroacetic acid solution was also added to it and homogenized at 6000 rpm for 15 minutes. After collecting the supernatant, 2 mL of it was combined with 6 mL of thiobarbituric acid. The mixture was heated for 20 minutes to 100°C, quickly cooled, and then centrifuged for 10 minutes at 6000 rpm. The absorbance of the supernatant was measured at 450, 532, and 600 nm, after it was collected. The MDA concentration was calculated according to the following equation:

$$\text{MDA} = [(6.45 \times (A_{532} - A_{600})) - (0.56 \times A450)]$$

Where: $A_{532:}$ Absorbance at 532 nm, A_{600}: Absorbance at 600 nm, A_{450}: Absorbance at 450 nm and 6.45 as well 0.56 are consonants

Texture analysis

On the texturometer TA. XT plus from Stable Microsystems, the samples' textures were evaluated. The stainless P/5 probe with a 5 mm diameter cylinder was used to measure hardness and adhesiveness. The probe's penetration depth was set to 5 mm. The probe moves at a speed of 2 mm/s.

Statistical analysis

Duplicate samples were taken for each parameter and 3 trials were conducted for each experiment. A total six observations were taken (n=6) for consistency of the results. The results were analyzed statistically for variance and Least Significant Difference (LSD) test as per Snedecor and Cochren (1989) and Means were compared by using Duncan's Multiple Range test (Duncan, 1995). Statistically analyzed data using SPSS-25 software were tabulated and interpreted.

RESULT AND DISCUSSION

Physiochemical characteristics of pet soap prepared from rendered chicken skin fat obtained by different rendering methods are given in Table 1.

Table 1: Physiochemical characteristics of pet soap prepared using dry, wet and microwave rendered chicken skin fat (Mean±SD) (n=6)

Parameters	DRF	WRF	MRF
TFM (%)	77.12±0.15^{B}	75.16±0.09^{A}	78.713±0.15^{C}
pH	9.40±0.04^{A}	9.45±0.03^{A}	9.45±0.03^{A}
Yield (%)	90.72±0.17^{A}	90.84±0.19^{A}	90.91±0.17^{A}
Matter insoluble in water (%)	1.11±0.03^{A}	1.11±0.03^{A}	1.12±0.03^{A}
Moisture (%)	5.89±0.01^{B}	6.09±0.00^{C}	5.53±0.01^{A}
Percentage chloride	0.13±0.02^{A}	0.12±0.01^{A}	0.12±0.01^{A}
Total alkali content (%)	0.72±0.02^{A}	0.74±0.01^{A}	0.73±0.01^{A}
Free alkali content (%)	0.03±0.00^{A}	0.03±0.00^{A}	0.023±0.00^{A}
Foam stability (%)	89.45±0.13^{B}	88.01±0.17^{C}	92.32±0.18^{A}
Cleansing power	Very good	Very good	Very good
Washing power	Normal	Normal	Normal

Mean between treatment (kind of rendered fat) with different alphabetic superscript differs significantly (P<0.05); DRF- Dry Rendered Fat, WRF- Wet Rendered Fat, MRF- Microwave Rendered Fat

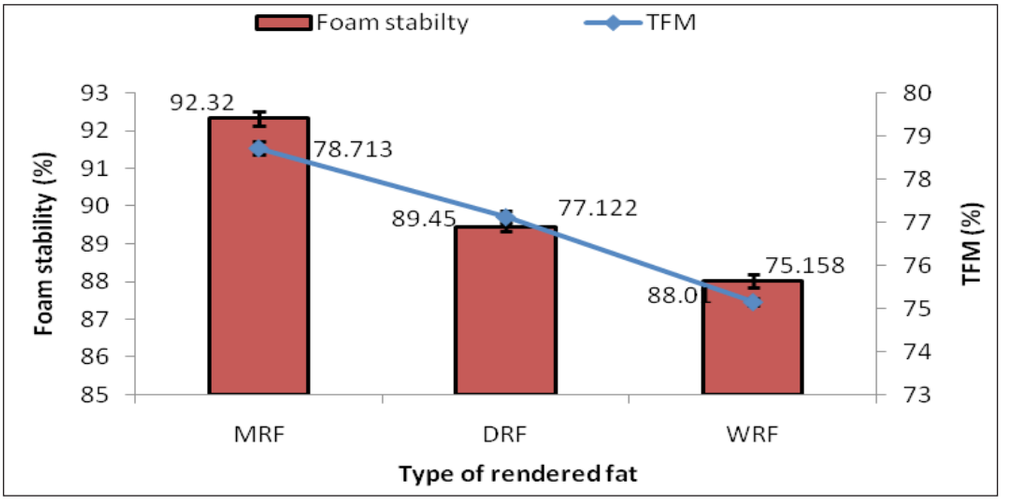

Fig. 1: Effect of dry, wet and microwave rendering on TFM and Foam stability values of soap prepared with rendered fat extracted from deserted poultry sleeves. DRF- Dry Rendered Fat, WRF-Wet Rendered Fat, MRF- Microwave Rendered Fat

Total fatty matter content measures the amount of different fatty acids present in soap and soaps with high TFM produces more leather, last longer, and have more efficient cleaning action (Sharma *et al.,* 2020). International Organizations set the criteria that good-quality soaps must have TFM values above 76%. The TFM value was significantly (P <0.05) higher in pet soap prepared from microwave-rendered CSF than dry or wet rendered CSF soap. The microwave-rendered CSF and dry-rendered CSF soap has TFM value higher than grade 1 (76%) International Organization standards as well as BIS standards. The variation in TFM values may be due to different moisture level and fatty acid quality of rendered fat. Higher TFM confirms that soaps are less harsh on the skin and do not induce dryness in "bathing" bars. Dry skin needs soaps that contain a higher TFM content (80%), which make skin smooth by rehydrating and additionally, the high oil content within the soap acts as a lubricant (Mak-Mensah and Firempong, 2011). The pH of soap was in the range of 9.40 to 9.45. When comparing the soap

samples made from dry, wet, and microwave-rendered CSF, there was no significant (P>0.05) difference. The pH of soap was comparable to the reported values of 9–11 (Oyedele, 2002) and 9.38 (Mak-Mensah and Firempong, 2011). Normal and healthy canine skin has a pH in the range of 5.5–7.2, which is more alkaline than the pH of human skin (5.4-5.9) (Mak-Mensah and Firempong, 2011). High pH values in soaps are due to the incomplete hydrolysis resulting from the saponification process, which can be overcome by adding excess fat or oil to reduce the harshness of the soap. Most tested commercial soaps had a pH between 9 and 10 (Tarun *et al*., 2014).

The moisture content of all soap samples was very low (5.53-6.09%). A significant (P< 0.05) difference was observed between samples of dry, wet, and microwave-rendered CSF-based soap. The other studies reported much higher moisture contents that ranged from 24.90% to 43.24% (Sanaguano-Salguero *et al*., 2018). The lower moisture content of developed soap could be due to a different recipe for soap preparation and non-addition of any substances or additives that help in water retention. The high moisture content supports hydrolysis and alterations inside the soap itself. Some of the best soap producers declare a maximum of 14% moisture in their products (Betsy *et al*., 2013). There was no significant (P> 0.05) difference in total alkali and free alkali content of pet soap prepared using differently rendered CSF. The total alkali content shows low values ranging from 0.73 to 0.74%. The lower this value is, the better the quality of the soap (Betsy *et al*., 2013). The values for all of the soap samples tested were within the recommended limits. One of the most important parameters that determine the abrasiveness of any given soap is free alkali (Onyekwere, 1996). The free alkali content was also very low (0.025 to 0.027%). Almost similar values for free alkali content were reported by Mak-Mensah and Firempong (2011) and Osuji *et al*. (2013), in toilet soap prepared from neem seed oil (0.06%) and palm oil sludge (0.06 to 0.09%), respectively. The free alkali for pet soap samples was found between the limits of recommendation (maximum 0.5%). There was no significant change (P> 0.05) in yield of pet soap also and it ranged from 90.72 to 90.91%. Mishra (2016) prepared soap from five different types of oils and reported that the yield varies from 81.3 to 92%. The yield of soap depends oil or fat used for making it, carboxylic acid and base that make up the soap.

The percentage of substances insoluble in water was almost similar in all treatments (1.11-1.12%). Traditional Lux and Joy soaps contained 5.77 and 3.88% water-insoluble ingredients, respectively (Oyekunle *et al*., 2021). The standard for percentage of water insoluble substance for soap is not given by BIS. When making soap from cocoa pods and palm bunches, Oyekunle *et al*. (2021) reported that the percentage of material that was insoluble in water varied from 5.62 to 8.94% for soap made from cocoa pods and from 8.83 to 15.04% for soap manufactured from palm bunches. The amount of soap used will depend on the amount of matter insoluble in water present, because higher levels results in more soap being used. The percentage chloride levels in soap must be determined since too much chloride can cause soap to break (Taiwo *et al*., 2008). There was no significant difference observed in chloride level among different soap samples. The values of the percentage chloride were in the range of 0.12 to 0.13%. The percentage chloride for all soap samples was below than the value of 1.15% reported by Mak-Mensah and Firempong (2011). Taiwo *et al*. (2008) attributed higher chloride content of soap to use of chlorinated water to dissolve NaOH pellets.

There was a significant (p<0.05) difference in the stability of foam in soap prepared from differently rendered CSF. The results showed that the soap prepared from microwave rendered fat has higher foam stability (92.32%) than dry (89.45%) or wet (88.01%) rendered fat. This may be attributed to the fact that fatty acids in the oils used have a function to stabilize the foam. Fatty acids like palmitic acid can stabilize foam, while oleic acid can produce stable and soft foam (Kumar *et al*., 2008). These fatty acids are present in higher concentrations in chicken fat. The foam stability of a soap with white tea extract ranged from 72.19–81.22% (Widyasanti and Hasna, 2016) and soap with tomato extract showed foam stability of 86.6–93.75% (Agustina *et al*., 2018). Although, percentage of foam stability is not listed in the BIS as it is not related to the cleansing of the skin, it plays an important role in soap selection. When using soap, the foam plays a role in moving the fragrance of the soap to the skin and determining consumer preference. The majority of consumers prefer soap with a lot of foam that is stable. The additional physical investigation of the soaps reveals that all of them had excellent cleansing qualities, typical washing properties, and extremely stable lathering properties.

Effect of rendered fat from dry, wet and microwave rendering on the oxidative stability of pet soap is given in Table 2**.** Free fatty acids are fatty acids that exist in soap, but do not bind to NaOH and triglycerides. They exist in the soap because they don't undergo a saponification reaction. Free fatty acids plays a significant role in defining soap quality, despite the fact that they can reduce the soap's odour and colour stability (Berneck and Maruka, 2013). Free fatty acids can improve the scent, moisturising properties, and foaming or lathering quality. Free fatty acid content should be less than 2% in accordance with ISO guidelines. A significant ($P<0.05$) difference was observed in the free fatty acid content of all soaps and varied from 0.38 to 0.71%. The high FFA content in soap results in rancid smell due to oxidised free fatty acids. According to Sany and Fahmi (2019), for FFA the maximum limit for good soap quality is 2.5%. Peroxide value is used as a lipid oxidation monitor (Winkler–Moser *et al*., 2020). The peroxide value of all soaps varied significantly ($P<0.05$) and it ranged from 1.82 to 2.14%. The peroxide value of soap prepared from wet rendered CSF was significantly higher, which may be due to higher moisture content of rendered fat that may be responsible for the oxidation of fatty acids present in fat. MDA has been identified as a lipid per-oxidation marker (Gawel *et al*., 2004). MDA levels in wet rendered CSF soap were higher than dry and microwave rendered CSF soap. There was a significant ($P<0.05$) difference in MDA values between all of the samples. MDA was 0.87 µg/g in dry-rendered fat soap, 0.97 µg/g in wet-rendered fat soap and 0.807 µ/g in microwave-rendered fat soap. Atonic *et al*. (2020) prepared soap from waste cooking oils and concluded that malondialdehyde (MDA) increased from 1.94 to 2.33 µg/g for olive oil fresh and fried pairs and from 3.43 to 4.10 µg/g for rapeseed/palm oil, fresh/fried pairs. MDA levels were higher in soap prepared from wet rendered fat than in soap prepared from dry or microwave rendered fat, which could be due to the higher moisture content of this fat, which accelerates fat per-oxidation.

Table 2: Effect of rendered fat from dry, wet and microwave rendering on the oxidative stability of pet soap (Mean ± S.E) (n=6)

Parameters	DRF	WRF	MRF
Free Fatty acid (%)	0.51 ± 0.01^{B}	0.71 ± 0.01^{C}	0.38 ± 0.01^{A}
Peroxide value (meq/kg)	1.99 ± 0.07^{AB}	2.14 ± 0.06^{C}	1.84 ± 0.07^{A}
MDA value (µg/gm)	0.86 ± 0.04^{B}	0.97 ± 0.04^{C}	0.81 ± 0.04^{A}

Mean between treatment (kind of rendered fat) with different alphabetic superscript differs significantly ($P<0.05$) DRF- Dry Rendered Fat, WRF- Wet Rendered Fat, MRF- Microwave Rendered Fat.

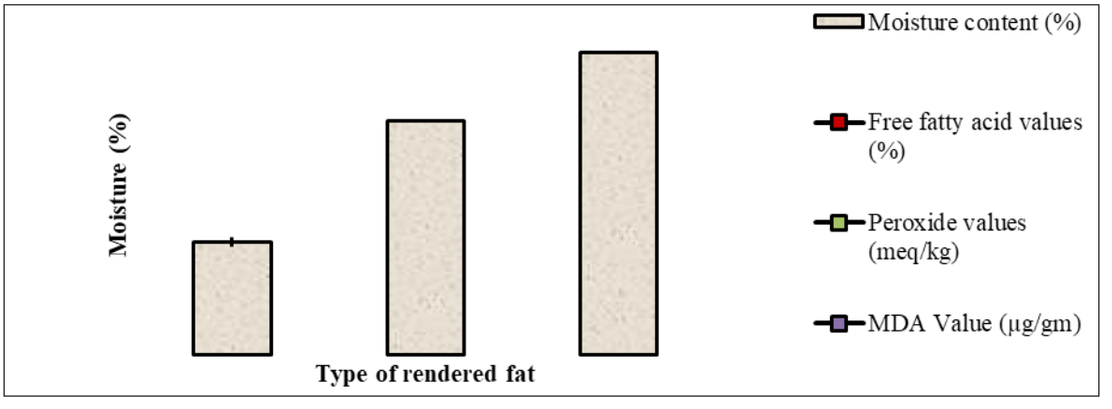

Fig. 2: Effect of dry, wet and microwave rendering on moisture content, free fatty acid, peroxide values, and MDA values of soap prepared with rendered fat extracted from deserted poultry sleeves, DRF- Dry Rendered Fat, WRF- Wet Rendered Fat, MRF- Microwave Rendered Fat

The textural characteristics of all developed soap samples are shown in Table 3. The literature's descriptions of soap texture metrics have been lacking. Consequently, comparison with the results of other authors is not possible or is not leading to clear conclusions. The soap sample with the least moisture showed the highest hardness (Sany and Fahmi, 2019). The microwave-rendered CSF soap had a significantly higher (P<0.05) hardness, followed by dry and wet rendered CSF soap. Atonic *et al*. (2020) prepared soap from waste cooking oils and analyzed that the hardness of fried olive oil soap was 8538 g, followed by fresh olive oil at 5268 g, fried rapeseed oil at 3841 g, and rape-palm oil soap at 3619 g. Similar to hardness, the maximum value for adhesion was found in samples with the lowest moisture level. The adhesiveness values for microwave rendered fat (-743 g) was significantly higher (P<0.05), followed by dry rendered fat (-521.33 g), and was lowest in wet rendered fat (466.67 g).

Table 3: Textural properties of developed pet soap samples (Mean ± S.E.) (n=6)

Parameters	DRF	WRF	MRF
Hardness (g)	3794.33 ± 9.70^{B}	2909.33 ± 43.09^{A}	4363.00 ± 8.96^{C}
Adhesiveness (g)	-521.33 ± 11.37^{B}	-466.67 ± 5.34^{C}	-743 ± 6.08^{A}

Mean between treatment (kind of rendering) with different alphabetic superscript differs significantly (P<0.05) DRF- Dry Rendered Fat, WRF- Wet Rendered Fat, MRF- Microwave Rendered Fat.

CONCLUSION

This study was conducted to prepare a utility pet soap using rendered fat obtained from chicken skin by subjecting it to different rendering methods, with objective of preventing the waste of valuable poultry skin and simultaneously protecting environment. The rendered CSF in admixture had acceptable saponification values to be processed into soap. The soap had acceptable physicochemical characteristics like TFM, free alkali content, total alkali content, percentage chloride, matter insoluble in water, moisture, and pH values and were comparable to the BIS standards for soap. The microwave rendered chicken skin fat was best for preparing pet soap among all of the treatments. The utilization of rendered chicken skin fat obtained from deserted poultry sleeves, in manufacturing of pet soap could be an alternative use of this important by-product.

REFERENCES

AOCS. 1995. Official Methods and Recommended Practices of AOCS, 7th Edn. *.AOCS Press, Champaign, IL (USA).*

Abid, M. and Touzani, M. 2017. First step of waste chicken skin valorization by production of biodiesel in Morocco. *J. Mater. Environ. Sc.,* **8**: 2372-2380.

Agustina, L., Yulianti, M., Shoviantari, F. and Sabban, I. F. 2018. Formulation and evaluation of herbal liquid soap containing tomatoes (*Solanum lycopersicum* L.) as antioxidants. *J. Sains dan Kesehatan*, **4**(2): 104-110.

Berneckė, S. and Maruška, A. 2013. Analysis of free fatty acids in soap samples by means of gas chromatography-mass spectrometry. *Chemija,* **24**(4): 307-311.

Betsy, K.J., Jilu, M., Fathima, R. and Varkey, J.T. 2013. Determination of alkali content & total fatty matter in cleansing agents. *Asian J. Appl. Sci. Technol.,* **2**(1): 8-12.

Bureau of Indian standards. 2006. Toilet soap according to IS No: 2888:2004, 3rd revision November, 2006.

Dunkan, D.B. 1995. Multiple ranges and multiple F test". *Biometrics*, **1**: 1-8.

Gangwar, M. 2019. Extraction, characterization and utilization of fat from poultry sleeves. M.V.Sc. Thesis, Deemed University, IVRI, Izatnagar.

Gaweł, S., Wardas, M., Niedworok, E. and Wardas, P. 2004. Malondialdehyde (MDA) as a lipid peroxidation marker. *Wiad. Lek*., **57**(9-10): 453-455.

Khalifa, I., Barakat, H., El-Mansy, H.A. and Soliman, S.A. 2016. Improving the shelf-life stability of apple and strawberry fruits applying chitosan-incorporated olive oil processing residues coating. *Food Packag. Shelf-Life*, **9**: 10-19.

Kumar, K.S., Ganesan, K. and Rao, P.S. 2008. Antioxidant potential of solvent extracts of *Kappaphycus alvarezii* (Doty) Doty–An edible seaweed. *Food Chem*., **107**(1): 289-295.

Mak-Mensah, E.E. and Firempong, C.K. 2011. Chemical characteristics of toilet soap prepared from neem (*Azadirachta indica* A. Juss) seed oil. *Asian J. Plant Sci.,* **1**(4): 1-7.

Mishra, D. 2013. Preparation of soap using different types of oils and exploring its properties. Doctoral Thesis. National Institute of Technology, Rourkela.

Ogbuewu, I.P., Odoemenam, V.U., Omede, A.A., Durunna, C.S., Emenalom, O.O., Uchegbu, M.C. and Iloeje, M.U. 2012. Livestock waste and its impact on the environment. *Sci. J. Rev*., **1**(2): 17-32.

Onyegbado, C.O., Iyagba, E.T. and Offor, O.J. 2002. Solid soap production using plantain peel ash as source of alkali. *J. Appl. Sci. Environ. Manag.,* **6**(1): 73-77.

Onyekwere, C. 1996. Cassava Peels Ash. An Alternative Source of Alkali in Soap Production. Thesis of Chemical Engineering, University of Port Harcourt, Port Harcourt.

Osuji, C.N., Akunna, T.O. and Ahaotu, E.O. 2013. Use of palm oil sludge in toilet soap production. *Int. J. Appl. Sci. Eng.,* **1**: 73-78.

Owoicho, I. 2021. Quality assessment of soaps produced from bleached palm oil and *Moringa oleifera* seed oil. *Glob. J. Eng. Technol. Adv.,* **7**(1): 001-005.

Oyedele, A.O. 2002. The skin tolerance of shea fat employed as excipient in topical preparations. *Niger. J. Natur. Prod. Med*., **6**: 26-29.

Oyekunle, J.A., Ore, O.T., Ogunjumelo, O.H. and Akanni, M.S. 2021. Comparative chemical analysis of Indigenous Nigerian soaps with conventional ones. *Heliyon*, **7**(4). e06689.

Roila, A., Salmiah, A. and Razmah, G. 2001. Properties of Sodium Soap Derived from Palm-Based Dihydroxystearic Acid. *J. Oil Palm Res.,* **1**: 33-38.

Sanaguano-Salguero, H., Tigre-Leon, A. and Bayas-Morejon, I.F. 2018. Use of waste cooking oil in the manufacture of soaps. *Int. J. Ecol. Dev.*, **33**: 19-27.

Sany, I.P. and Fahmi, A.S. 2019. Physicochemical Characteristics and Antioxidant Activity of Solid Soap Enriched with Crude *Eucheuma cottoni* Extract. *IOP Conf. Ser.: Earth Environ. Sci.,* **246**(1): 012066.

Sharma, K.P., Belbase, A. and Neupane, U. 2020. Quality control and evaluation of certain properties of soaps available in butwal sub-metropolitan City, Nepal. *Butwal Campus J*., **2**(1): 6-12.

Snedecor G.W. and Cochran, W.G. 1995. Statistical Methods, 8th edition New Delhi: oxford and IBH Publishing Company. pp. 72-148.

Taiwo, A., Oluwadare, I., Shobo, A. and Amolegbe, S. 2008. Physical and chemical characteristics of soap. *J. Sci. Res. Essay*., **3**: 515-517.

Tarun, J., Susan, J., Suria, J., Susan, V.J. and Criton, S. 2014. Evaluation of pH of bathing soaps and shampoos for skin and hair care. *Indian J. Dermatol*., **59**(5): 442.

Vikman, M., Siipola, V., Kanerva, H., Slizyte, R. and Wikberg, H. 2017. Poultry by-products as potential source of nutrients. *Adv. Recycl. Waste Manag.,* **2**: 1-5.

Widyasanti, A. and Hasna, A.H. 2016. The study of transparent soap making from virgin coconut oil-based with the addition of white tea extract as an active ingredients. *J. Penelit. Teh Kina.,* **19**(2): 179-195.

Winkler–Moser, J.K., Hwang, H.S. and Kerr, B.J. 2020. Changes in markers of lipid oxidation and thermal treatment in feed-grade fats and oils. *J. Sci. Food Agric.,* **100**(8): 3328-3340.