Utilization of Tannery Fleshing Fat for Making Soap

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Abstract

Research on making soap using fat of tannery fleshings is aimed to utilize the existing fat left in the fleshings, to assist overcoming the environmental pollution problem and find an alternative of raw material availability for making soap. The target to be achieved is the overcoming of environmental problem of pollution caused by fleshing waste. The fat is taken from the fleshings by subjecting them onto heating such as boiling, steaming, and then the fat is treated by purification and impurification. Each treatment result is tested on their value of saponification, acid, and free fatty acids, and un – saponified fat. The variation of fat in making bath soap is 55%, 60%, 65%, 70% and 75%, and NaOH added is 11%, 14%, 17%, 20% and 23%. Variation of fat in making laundry soap is: 0%, 15%, 30%, 45% and 60%, whereas NaOH added is: 17%, 20%, 23%, 26% and 29%. Test results of bath soap and laundry soap, using either fleshing fat that has not been purified and after purification of almost all the variations meet the SNI 06-3532 – 1994, the bath soap and SNI 06-2048-1990, the laundry soap. The testing parameters include: moisture content, the amount of fatty acids, alkali-free, free fatty acids and mineral oils. The quality of soap by using purified fleshing fat is obviously higher than using fleshing fat that has not been purified. This can be seen from the results of testing.

Keywords: fleshing fat, soap, environment

Introduction

Tanning industry produces a very large volume of solid wastes of about 800 kgs / ton salt cured hides/skins. The solid wastes are in the form of trimmings, fleshings, splittings, shavings and sludge. The volume of solid waste in the form of fleshings is about 70-230 kgs / ton of salt cured raw skins (Jost, Pdt.1990).

Fleshings is a type of solid wastes which becomes a big problem for leather tanning industry, containing protein, and easily decomposed, therefore it is potential to pollute the environment.

It is expected from this study that a product will be generated from the large volume and un-utilised yet fleshing fat. The fat must be separated or reduced in advance, because it can interfere in the further process. This fleshing fat reduction results can be used for other industries such as soap and others.

Animal fat (tallow) is a saturated carboxylic acids triglyceride compounds classified as Esther groups. Esther may be able to be saponified using alkali and producing soap. The main raw material in the manufacture of soap is fat and oils, alkali, and other inorganic materials. Fat used in soap making can be a vegetable fat or animal fat. Alkali which is used to make soap is caustic soda (NaOH). Sodium hydroxide is most commonly used for the manufacture

of soap by reaction with fats (glycerides and fatty acids) to get solid soaps to be bars (Bailey, 1946; Norris Shreve, 1967).

Fat is a large group of natural molecules consisting of the elements of carbon, hydrogen, and oxygen including fatty acids, sterols, vitamins are soluble in fat (e.g. A, D, E, and K), monoglycerides, diglycerides, phospholipids, glycolipids, terpenoids and others (Indonesian Wikipedia, Free Encyclopedia, 2010). Fat is specifically a term for animal oils. At room temperature, apart from either of its solid or liquid forms, it is present in the body tissue called adipose.

It is described further in the Indonesian Wikipedia, Free Encyclopedia, (2010), that the fatty acids (fatty acid, fatty acyls) are aliphatic compounds with carboxyl groups. Together with glycerol, they are the main constituent of vegetable oils or fats and are the raw material for all lipids in living things. Acid is easily found in cooking oil, margarine, or animal fats and able to determine the nutritional value. Naturally, fatty acids can be found either in freely form (due to the hydrolyzed fat) or bonded as glycerides.

According to Sri Sutyasmi (2006), the separation of fleshings fat may be carried out by heating, i.e. by boiling or by using autoclave. However, viewed from the results obtained, boiling method is better than heating by using autoclave with the reason that by using autoclave the remains of flesh is destroyed generating bluish color of the fat contrary with clear yellow fats obtaining by boiling.

Herman (2005) explains that the process of fats refining includes bleaching process, neutralization, alkali refining, and odor removal (deodorization).

Bleaching is a stage of refining process to remove undesirable colloidal in the oil in order to reduce the color or substrate through chemical and physical processes. Physical bleaching process involves oxidation, reduction or absorption which causes colored parts become more soluble and easily removed during bleaching. Chemically bleaching can change the color capability of the molecule to absorb light, i.e. by changing the unsaturated degree

Neutralization is a process to separate the free fatty acids from oils / fats by reacting free fatty acids with alkali or other reagents.

Alkali refining is the most effective method to reduce the degree of free fatty acids, phosphatides, metal ion, pigment, carbohydrate, protein oxidation byproducts, hydrocarbons and components contained in the oil / fat.

Deodorization is one of oil refining phases which aims to eliminate the unpleasant odor and flavor in the oil / fat and can eliminate undesirable flavor.

Materials and Methods

The study is divided into 2 study of making soaps, those are making bath soap and making laundry soap from fleshing fats that have not been refined and fleshing fats that have been purified. Manufacture of bath soap and laundry soap from fleshing fats that have not been refined and highly refined is carried out by using a formula with a variety of fat of 55%, 60%, 65%, 70% and 75%, the variation of NaOH is 11%, 14%, 17%, 20% and 23%.,

while the addition of other chemicals is arranged in regular way.

Materials

Materials used in this study are goats and sheep skin fleshings from tannery, chemicals to neutralize the fleshings (ZA, Teepol, pH stick), chemicals to manufacture soaps (NaOH, coconut oil, water glass, alcohol, gliycerine, CMC, pigment materials, fragrance materials) and chemicals to refine fats (H_2O_2, HNO_3, H_2SO_4, NaCl, NaOH).

Tools

The tools used in this research is tanning drums, plastic drums, hoses, plastic buckets, stainless steel pan, gas stoves, filters, plastic jars, steam, scales, glassware, blenders, mixers, thermometer, soap mold, stirrer.

Method

Leather fleshing waste of sheep / goats taken from the tanning industry is washed in the drum with running water until the dirt on fleshing waste is removed. Subsequently they are neutralized in deliming process using the following recipe : water: 200-300%, ZA: 5-8%, run the drum for 30 minutes, then add 2% HCL, run for 30 minutes. They are then added with 1% teepol, run for 60 minutes. After that it is washed and checked for neutral pH, washed again with running water and then they are drained. The next stage is separating the fat from fleshing waste by boiling and steam. This stage is carried out by boiling every 5 kg of fat in a stainless steel pan or in steam for 30-45 minutes, and then they are cooled. When the fat floats and separates from fleshings, the fat is taken to be the material of soap making. One can make the soap directly from the material of fat taken or it is refined first.

Method of fat Refining Process

Before it is used to make soap, the fat is physically and chemically refined first. Referred to physical process because of the process of weighing, heating, stirring and water separation from fat / oil. Whereas chemical process is because of the use of chemicals such as sulfuric acid (H_2SO_4), sodium hydroxide (NaOH), sodium chloride (NaCl), hydrogen peroxide (H2O2).

The refining process begins with solid fat weighing at 100 grams, it is then put into a glass beaker, melt the fat by heating, about 5 minutes, temperature 65 – 90^oC, add the absolute H_2O_2 as much as 1 ml into it, add 2% solution of Nitric Acid with variations of 20 ml, 25 ml and 30 ml, add sulfuric acid solution with various concentrations of 15%, 20% and 25% as much as 15 ml, heat 5 – 10 minutes, wash with a solution of 10% NaCl with 3 replications, neutralize with Na (OH) 1 N to pH 7 – 8, cool it.

Method of Soap Making

Fat obtained is weighed according to the recipe of the total weight, and then is mixed with alkali and other inorganic materials such as glycerin, alcohol, pigment, perfumes, water glass, NaCl. In warm conditions, the mixture is then molded and cooled to obtain toilet soaps and laundry soaps. Below is the recipe of soap making.

Table 1: Soap making recipes

No	Parameter	Variation (%)				
		S1 (%)	S2 (%)	S3 (%)	S4 (%)	S5 (%)
1	Fat (%)	55	60	65	70	75
2	Glycerin (%)	5	5	5	5	5
3	NaOH (%)	11	14	17	20	23
4	Water glass (%)	1	1	1	1	1
5	Alcohol (%)	1	1	1	1	1
6	Fragrances and pigmt (%)	1	1	1	1	1
7	NaCL (%)	1	1	1	1	1
8	Coconut oil (%) - Bath / laundry soap with fat variation - Bath / laundry soap with NaOH variation	 20 5		 10 5	 5 5	 0 5

Results and Discussion

1. Results of Separation of Fleshing Waste Fat

Fats obtained from tannery fleshing wastes can be seen in Table 2 below.

Table 2: Results of separation of fleshing waste fat

Heating time (hour)	*Steam* (kg/5 kgs)	Boiled (kg/5kgs)
0,25	0,242	0,220
0,30	0,287	0,296
0,75	0,384	0,374
1,00	0,425	0,305

It can be seen from the above data that both ways of taking fat can be used, but even viewed from the better result obtained by the method of steam, the fat obtained is in grayish color, it indicates that the fat obtained from the steam is mixed with meat fleshing that blue-gray color. Good fats tallow color according to Anonymous (2010) is clear white and yellow.

2. Test Results of Fleshing Fat before Refining and After Refining

Lipid test results of fleshing waste can be seen in Table 3 below.

Table 3: Test results of fleshing fat before and after refining

Goat and Sheep Skin Fleshing Fat		
Parameter	**Pre-Refining**	**Post Refining**
Un-saponified fat (%)	1.44	3.38
Fat content (%)	91.3134	92.6904
Impurities (%)	0.0567	4.048
Acid number (%)	1.72	4.50
Saponification numbers (%)	167.01	200.95
Yod number (%)	43.4195	37.2147
Free fatty numbers (%)	0.86	0.08
Odor	Still a bit smelly	No odor
Color	Yellow / slightly turbid	Bright, clean white

The fat of the test data shows that the fat before it is purified, saponification numbers high enough average of 200.95%, while the average rate small acid 1.72%,; little too free fatty acids, an average of 0.86%, saponified fat too small, ie, an average of 1.44%, so the fat isolated from the rest of fleshing the skin, it is possible for the manufacture of soap.

From the results of the test after the fat is refined, fat content is increased 1.51%, levels of impurities is increased 7,039%, acid number is increased 161%, saponification number is increased 16% and yod number is decreased 14%. Thus it can be said that the refining will increase the fat content and fatty acid number as well as saponification number. The visual inspection result shows that the fat has no smell and the colors become brighter (whiter).

3. Test Result of Bath Soap

a. Testing soap with fat variations

Test results with the soap-fat variations can be seen in Table 4. From the test data with the soap-fat variations, it can be seen that all variations meet SNI 06-3532-1994, except alkali-free that has a variety of F1 fat (55%) and F2 (60%).

Table 4: The test results for soap with variations in fat

NO	Parameter	FAT VARIATION					SNI
		F1 (55%)	F2 (60%)	F3 (65%)	F4 (70%)	F5 (75%)	
1.	Water content (%)	14,97	10,90	14,92	14,79	13,02	Max15
2.	The amount of fatty acids (%)	72,19	72,35	72,86	75,72	75,91	> 70%
3.	Free alkali as NaOH (%)	0,17	0,17	0,15	0,15	0,11	Maks 0,14
4.	Free fatty acid / neutral (%)	1,00	0,97	0,49	0,51	0,61	< 2,5%
5.	Mineral oil	neg	neg	neg	neg	neg	neg

- **Water content**

  The average value of the highest water content is obtained from fat 55% variation in the use of which is equal to 14.97%. The lowest water content values obtained from the use of fat 60% which is equal to 10.90%.

- **The number of fatty acids**

  There is no significant differences from each treatment variations with calculated F = 1.80 and F table = 3.79. The average value of the highest fatty acids 75.91% in the use of variations of fat 75%. The lowest value of 72.35% fatty acids from fat 60% variation in usage.

- **Free fatty acids and or neutral fats**

  There are very significant differences $P < 0.01$ between the use of fat 55% and 60% and the use of other fats. The average value of the highest fatty acids of the use fat 55% is 1.00%, while the lowest value of variation in the use of fat 65% is 0.49%.

- **Alkali-free calculated as NaOH**

  Based on the statistical analysis it turns out that there are no significant differences P <0.05 and each of the various treatments, the calculated F = 2.5 and F table = 3.79. Highest average value obtained in the use of 55% fat is as amount as 0.17% and the lowest average in the use of 75% fat is 0.11%.

  In addition, it can also be detected that the value of all the parameters of the formula F5, with the fat content of 75% meets the SNI 06-3532-1994. Therefore the variation of the F5 is defined as the basis for determining the variation of NaOH.

  Based on statistical calculations, it is known that there is no significant difference on each various treatments. F Calculated = 2.89 and F table = 3.79.

b. Testing soap with NaOH variation

The test results of bath soaps manufactured by adding NaOH variations can be seen in Table 5 below:

Table 5: The test results of bath soaps with NaOH variation

NO	TESTING ELEMENTS	NaOH VARIATIONS					SNI
		N11	N14	N17	N20	N23	
1.	Water content (%)	10,11	13,39	13,86	5,71	10,49	Max 15
2.	The amount of fatty acids (%)	77,75	71,92	75,44	70,57	82,73	> 70%
3.	Free alkali as NaOH (%)	0,18	0,19	0,11	0,16	0,02	Max 0,14
4.	Free fatty acid / neutral (%)	0,80	0,68	0,61	0,51	0,54	< 2,5%
5.	Mineral oil	neg	neg	neg	neg	neg	neg

Description: N11 to N23 is the use of NaOH of 11%, 14%, 17%, 20% and 23%. From the test results it can be seen that all variations meet SNI 06-3532-1994 except alkali-free at N11 and N14 (using NaOH 11% and 14%).

- **Water content**

  There is a very significant difference P <0.01 between the variation use of NaOH 20% and the variation use of other treatments. The average value of the highest water content of 17% variation use of NaOH is 13.86%, and the lowest water content of the variation use of NaOH 20% is at 5.71%.

- **The number of fatty acids**

  There is a very significant difference P <0.01 between the variation use of NaOH 23% and the other treatment variations. The average value of the highest fatty acids obtained from the use of NaOH 23% is 82.73%, while the lowest of 20% NaOH use is 70.57%.

- **Alkali-free calculated as NaOH**

  There is very significant difference P <0.01 between using NaOH of 23% and the use of other NaOH. Highest average value obtained from the variation use of NaOH 14% is of 0.19%, and the lowest of the variation in the use of NaOH 20% is 0.02%.

- **Fatty acids or fat-free and neutral.**

  There is a very significant difference, P <0.01 with Fcalculated 9.0 and Ftable 6.11. The difference is very noticeable between variation in the use of NaOH 11% and other variation of NaOH. The average value of the highest free fatty acids from variation in the use of NaOH 11% is as amount to 0.80% and the lowest of the variation in the use of NaOH 20%, is 0.51%.

4. Test Results of Laundry Soap

a. Results of laundry soap testing with variation of fat

The test results of laundry soaps manufactured by variations of fat are shown in the table below:

Table 6: The test results of laundry soap with variations of fat

ELEMENTS TESTING	FAT VARIATION					SNI 06-2048-1990			
	F1 (0%)	F2 (15%)	F3 (30%)	F4 (45%)	F5 (60%)	T3	T4	T5	T6
Free alkali calculated as NaOH (%)	0,039	0,039	0,096	0,070	0,018	max 0,1	max 0,1	max 0,1	max 0,1
Saponified fat (%)	7,90	6,83	3,80	1,70	0,57	max 2,5	max 2,5	max 2,5	max 2,5
oil pelicans	neg	neg	neg	neg	neg	neg	neg	neg	neg
The amount of fatty acids (%)	55,40	58,39	63,06	52,33	54,76	min 62	min 57,5	min 50	min 40

It can be learned from the table above that the value of all parameters of the formula F5 with 60% fat content meets the SNI 06-2048-1990 especially T5 and T6

- **Alkali-free**

  From the results of statistical calculations, it turns out that there is a very significant difference P <0.01 between F count 10 and the F table 6.11. The average value of highest free alkali of 0.096% derived from variations in the use of 30% fat. While the lowest value obtained from the use of variations of 60% fat is 0.018%.

- **Unsaponified fat**

  From the statistical calculation results there is highly significant difference P <0.01 between variations in the use of fat 0% with other variations. Besides that, there is also highly significant difference between the variations in the use of 45% fat and 60% and a variation of the use of other fats.

  The average value of highest unsaponified fat is obtained from 0% fat variation is of 7.90% and the lowest of 60% variation use of fat is of 0.57%.

- **The number of fatty acids**

  From the results of statistical analysis there is no significant difference P <0.05 between each treatment variations calculated as F 3.63 and F table 3.79. The average value of the highest amount of fatty acids is obtained from the use of fat 30% = 63.06%. The lowest value of the fatty acids is derived from fat variation use of 45% = 52.33%.

  From Table 6 it can be seen that the value of all the parameters of the formula F5, with fat content of 60% meets the SNI 06-2048-1990 especially T5 and T6. On that basis, the variation of the F5 is used as the basis for determining the variation of NaOH.

b. Test results of laundry soap with NaOH variation

Test results of laundry soap with variation of NaOH can be seen in the following table:

Table 7: Soap test results with NaOH variations

ELEMENTS TESTING	NaOH VARIATION					SNI 06-2048-1990			
	N17	N20	N23	N26	N29	T3	T4	T5	T6
Free alkali calculated as NaOH (%)	0,03	0,08	0,09	0,26	0,36	max 0,1	max 0,1	max 0,1	max 0,1
Saponified fat (%)	5,65	0,48	1,35	2,05	1,57	max 2,5	max 2,5	max 2,5	max 2,5
oil pelicans	neg	neg	neg	neg	neg	neg	neg	neg	neg
The amount of fatty acids (%)	54,59	52,21	55,15	49,45	48,83	min 62	min 57,5	min 50	min 40

Description: N17 to N28 is the percentage of use of NaOH 17% to 29%.

- **Alkali-free**

  There is no significant difference P<0.05 between each of the various uses of NaOH, F calculated and F table is 3.79. The average value of highest alkali-free is obtained from the variation use of NaOH 29% as amount to 0.36% and the lowest is in the variation use of NaOH 17% as amount to 0.03%.

- **Unsaponified Fat**

  There is significant difference P <0.01 between variations in the use of NaOH 17% and the other variations. The average value of the highest unsaponified fat is obtained in the variation of NaOH 17% as amount to 5.65% whereas the lowest value is obtained in the use 20% NaOH as amount to 0.48%.

- **The number of fatty acids**

  There is very significant difference P <0.01 between 29% variation in the use of NaOH and the other treatment variations. F calculated is 38.58 and F table is 6.11. The average number of highest fatty acid in the use of variation of 23% NaOH is

55.15% while the lowest of 29% variation in the use of NaOH is 48.83%.

Soap test results with variations of NaOH showed that almost all parameters can fulfil SNI 06-2048-1990, unless the value of the treatment N26 free alkali (NaOH 26%) and N29 (NaOH 29%) did not meet the SNI 06-2048-1990, thus also for parameters unsaponified fat on treatment N17 (NaOH 17%).

5. Test Results of Bath and Laundry Soap Using Refined Fleshing Fat

Soap making formula by using refined fleshing fat is shown on the table below:

Table 8: Soap test results using refined fleshing fat

NO	TESTING ELEMENTS	FAT VARIATION		NaOH VARIATION	
		Average	SNI 06-3532-1994	Average	SNI 06-2048-1990
1.	Water content (%)	14,59	Maks 15	14,59	
2.	The amount of fatty acids (%)	78,19	> 70%	45,15	Min.40%
3.	Free alkali as NaOH (%)	0,08	Maks 0,1	0,09	Maks 0,1
4.	Free fatty acid / neutral (%)	0,31	< 2,5%	0,78	< 2,5%
5.	Mineral oil	neg	neg	neg	neg

It can be seen from table 8 that all the parameters of the test results meet the SNI 06-3532-1994 for bath soap and SNI 06-2048-1990 for laundry soap.

Conclusion

1. Fat of fleshings can be material for making bath soap and laundry soap.
2. The test results show that the best bath soap is made by using 75% fat and 23% NaOH.
3. The test results show that the best laundry soap is made by using 60% fat and 23% NaOH.
4. The result of research on manufacturing of bath soaps can meet the SNI 06-3532-1994 for toilet soap, and laundry soap can meet SNI 06-2048-1990 laundry soap.
5. Soap produced by using materials of refined goat/sheep skin fleshing fat will produce better soaps (clear, odorless).
6. Utilization of fleshing fat for making soaps can be an alternative to overcome environmental problems of the leather tanning industry.

Suggestion

Solid waste in the form of fleshings should not be thrown away because the fat can be used among others for the manufacture of soaps.

1. This research could be developed for the manufacture of other products, e.g. oil for leather tanning process.

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