INITIAL ANALYSIS OF PIGSKIN ADULTERATION ON LEATHER PRODUCTS USING FTIR SPECTROSCOPY

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INITIAL ANALYSIS OF PIGSKIN ADULTERATION ON LEATHER PRODUCTS USING FTIR SPECTROSCOPY

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ABSTRACT

Leather products are part of daily fashion in Indonesia, such as bags, shoes, jackets, gloves, etc. Adulteration of raw materials for leather products can occur if there are no labels on these products. The existence of certain religion / belief that prohibit adherents from using certain materials, such as pork skin. Detection of adulteration has been carried out in various ways such as by PCR, GC-MS, HPLC, and FTIR methods. The FTIR method is known as an easy and inexpensive method to use. The objective of this study was to evaluate the capability of FTIR spectroscopy for lipid identification and initial analysis to detection of pig skin on leather proucts. Lipid extracts obtained from the various skin were scanned using FTIR spectrophotometer at 4000–500 cm^{-1}. It resulted spectral differences in several wavenumber (2951-3258 cm^{-1} and 1046-1428 cm^{-1}). At wavenumber 3020-2980 cm^{-1} there is a peak only in lard. The same result is also found in lipid spectra from leather products extraction. The FTIR spectroscopy is able to differentiate pigskin from goat and sheep skins through specific peaks in infrared spectra. This can be used as an initial analysis on determining the existence of skin adulteration in leather products. This study is prospective to be continued by chemometrics as a quantitative analysis

Keywords: Adulteration, FTIR Spectroscopy, Initial Analyisis, Leather Products, Pigskin

1. INTRODUCTION

Determination of authentication and detection of adulteration of material products is one of the main issues in the industrial field (Marikkar et al., 1995; Al Jowder et al., 1997). One of the risky products to be falsifite is leather products. Detection of product adulteration is important for consumer protection and also for certain religious reasons. In some countries, producers and sellers of leather products choose to use pigskin as a substitute for other skins, because prices are cheap and easy to obtain (Aida et al., 2005). The importance of labeling is influenced by the existence of certain religions / beliefs that prohibit adherents from using certain ingredients, such as the prohibition of the use of the element of pigs for Muslim and Jewish communities (Nakyisinge et al., 2012). Recently, the inclusion of material of animal origin is often not displayed clearly so scientific proof is needed to find out.

Various techniques or methods have been used for pig elemental analysis, such as Gas Chromatography-Mass Spectroscopy (Nizar et al., 2013), Liquid Chromatography-Mass Spectroscopy (LC-MS) (Czerwenka et al., 2010), Gas Chromatography Tandem Mass Spectrometry (GC-MS) (Oliveira et al., 2009), Differential Scanning Calorimetric (DSC) (Marina et al., 2009; Nurrulhidayah et al., 2015), High Performance Liquid Chromatography (HPLC) (Saeed et al., 1989; Marikkar et al., 2005) , Electronic Nose

(Nurjuliana et al., 2011), and DNA-based methods using the polymerase chain reaction (PCR) method (Che Man et al., 2011; Erwanto et al., 2014; Maryam et al., 2015). Some methods that have been done have weaknesses because it requires a long time and expensive costs in detecting adulteration in food. Therefore, routine methods that are fast, accurate, inexpensive, and easy to use are needed. One ideal method to be used in laboratories is Fourier Transform Infrared (FTIR) spectroscopy. Aplication of FTIR for initial analysis on leather products is appropriate to be studied.

2. METHODS

Lipid extraction

Lipid extraction using Soxhlet method was performed according to AOAC (1995). Raw leather and leather products in the form of leather are obtained from the market and leather distributors. A-50.0 g of samples was wrapped with filter paper and placed into the Soxhlet apparatus. A-250 mL of n-hexane was used as extracting solvent. The extraction was performed for 8 h at 70°C (±50 cycles). The lipid extract was added with anhydrous sodium sulfate, mixed, filtered by filter paper, and then evaporated until the solvent was completely removed. The resulting lipid fraction is then used for FTIR spectral measurements.

FTIR spectral measurements

The lipids obtained by lipid extraction were placed in attenuated total reflectance (ATR) crystal at ambient temperature (25°C). The spectrum was acquired in the wavenumbers region of 450–4000 cm^{-1} using FTIR spectrophotometer (Perkin-Elmer, Singapore).

Data analysis

The spectrum from FTIR spectral measurement results were analyzed descriptively by comparing of several skin species from raw skin and leather

3. RESULTS AND DISCUSSION

Lipid extraction

Raw material skin and leather have extracted by sokhlet method, and the solvent used by n-hexane. N-hexane solvent is very suitable for use in the extraction of fat on the skin. This is because n-hexane is non-polar, just like fat which is also non-polar and n-hexane is easily evaporated because it has a low boiling point of 69˚C (Erwanto et al, 2016). The extraction of fat from all types of species produced yellowish and thick oil, but specifically in sheep skin fat produces oil that is easily frozen at room temperature, while others do not.

FTIR Analysis of fresh skin lipid

The FTIR spectra of lipid obtained from four species skin have similar profiles. Figure 1 showed lipid spectra of pig, goat, sheep, and cattle skin lipid. Infrared spectra is read at 4000-550 cm^{-1}, which is the middle region. Many molecules have a strong absorbance in the middle infrared region. Many types of samples including solids, liquids, gases, semisolids, powders, polymers, organic, inorganic, biological substances, pure substances, and mixtures can be measured in the middle region (Smith, 2011).

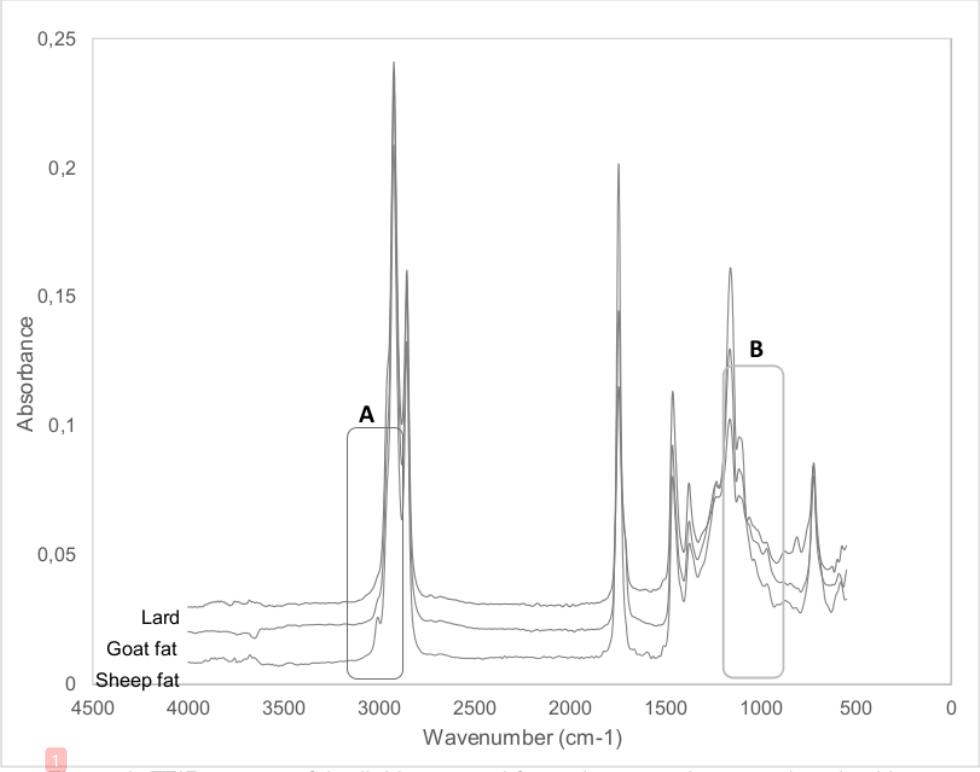

Figure 1. FTIR spectra of the lipid extracted from pig, goat, sheep, and cattle skin.

The results showed at a glance that there is no difference in the peak point in each fat, but it observed in more detail, there are some different peak point in the absorption of functional groups. There are at least 2 different spectra between each of the sources 2951-3258 cm^{-1} (a) and 1046-1428 cm^{-1} (b).

FTIR Analysis of lipid from leather products

Figure 2 showed that the spectra of three leather products have characters that are almost the same as the spectra of raw skin.

Goat fat

Sheep fat

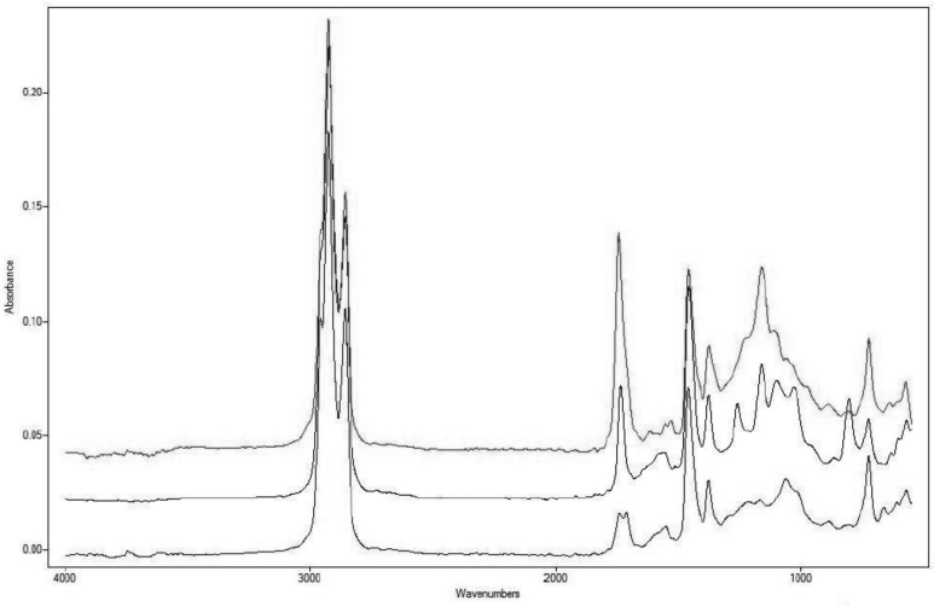

Figure 2. FTIR spectra of the lipid extracted from pig, goat, and sheep leather

Based on the results in Figure 2, wavenumber of the spectra is enlarged to be in the range of 3000-2800 cm^{-1}. The magnification of the area is shown in Figure 3. In that range, there is a peak in the spectra of pig skin leather lipid, while other types of leather do not have peaks in the wavenumber, this is also found in the raw skin spectra.

FTIR Analysis of lipid from commercial fatliquoring agent

In softy leather, as in leather products in this study, the addition of a fatliquor agent will improve the leather quality. Fatluquoring used fatliquor agent which is generally derived from the fat element, so that it can affect the spectra on crust skin (Covington, 2009). Fatliquoring is one of the important stages in the final process of tanning the skin so that it gets the desired leather character, such as the soft character on the glove or the medium hard on lining or upper shoes (Zarlok et al., 2014). This is thought to affect the fat spectra on the leather.

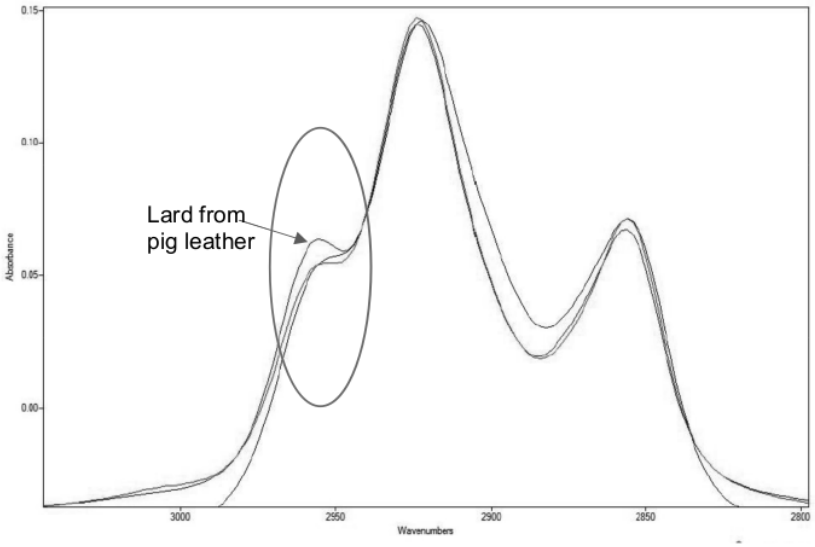

Figure 3. The enlarged FTIR spectra at wavenumber regions 3000-2800 cm^{-1}

Three types of fatliquoring agents or commercial fatliquors have been analyzed by FTIR in Figure 4. In the range of wavenumber 3700-3000 cm^{-1} there is a peak which showed the group H = O. This can be interpreted that the fatliquor still contains water (H_2O), while the main source of fatliquor is fat, so it is suspected that the three fatliquors contain surfactants that can bind fat and also water at the same time.

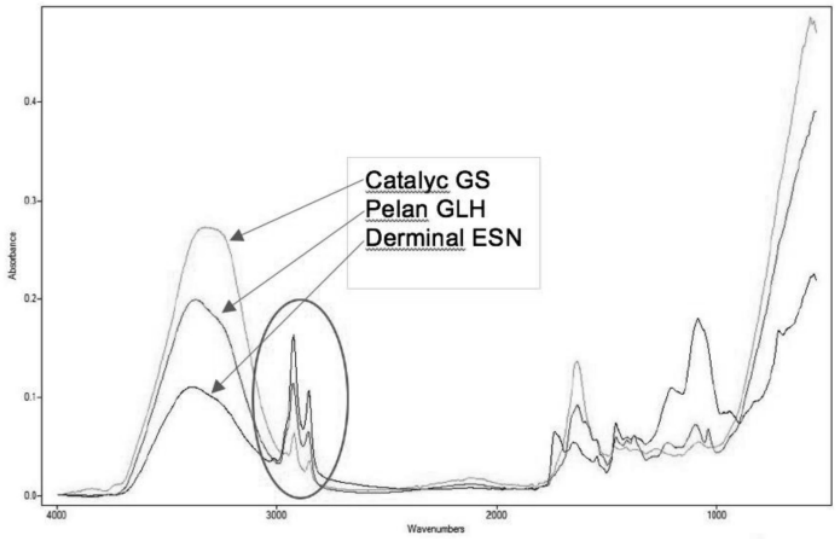

Figure 4. FTIR spectra of the lipid extracted from fatliquoring agent (Catalyc GS, Derminal ESN, dan Pelan GLH)

In wavenumber 300-2800 cm^{-1} there is a peak which has almost the same character in the leather fat spectra. Figure 5 showed the magnification of the peak of the fat spectra. Based on these results it was found that the wavenumber had similarities with the spectra of goat and sheep crust skin although the absorbance of fatliquor was relatively higher, but did not have the same characteristics as pig leather.

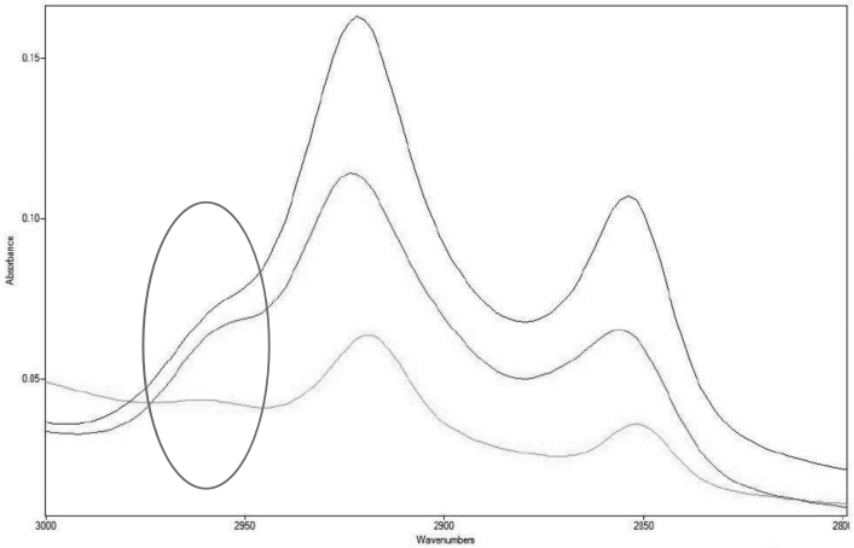

Figure 5. The enlarged FTIR spectra of commercial fatliquoring agents at wavenumber regions 3000-2800 cm^{-1}.

4. CONCLUSION

Lipid from skin extracts tested by FTIR have produced spectral differences in several wavenumber (2951-3258 cm^{-1} and 1046-1428 cm^{-1}). At wavenumber 3020-2980 cm^{-1} there is a peak only in lard. The same thing is also found in lipid spectra from leather products extraction. The addition of fatliquor did not affect the specificity of pig skin rind spectra. The FTIR spectroscopy is able to differentiate pigskin from goat and sheep skins through specific peaks in infrared spectra. This can be used as an initial analysis on determining the existence of skin adulteration in leather products. This study is prospective to be continued by chemometrics as a quantitative analysis

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