# A new latent fingerprint method using natural powder purple sweet potato (*Ipomoea batatas L. Poiret*)

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## Abstract

Fingerprint is one of human identity which cannot be changed or changed. In addition, it is also from a fingerprint that someone can be recognized. Several development methods can visualize latent fingerprints using natural ingredients. This study was aimed to develop the purple sweet potato powder method as a visualization of latent fingerprints. The purple sweet potato powder method was developed on five media, namely: aluminum foil, transparent plastic, plastic cups, CDs, and white paper. The development was carried out on a purple sweet potato tuber by applying purple sweet potato powder to a media that previously had the sebum content of a fingerprint. Purple sweet potato powder used were several kind of sizes between 60 to 200 mesh. This research was carried out in the INAFIS regional police laboratory. The results of fingerprint purple sweet potato powder was formed brownish purple and with clear color contrast at sizes 100 and 200 mesh. The shape of the fingerprint pattern obtained from the sample has the following patterns: radial loop (11.6%), ulnair loop (44.1%), plain whorl (33.3%) twinted loop and arch (0.8%). In this method visualization was clearly visible on the surface of aluminum foil and CD. The results of the determination of latent fingerprint visualization between tribes and blood groups were the most common patterns found are ulnair loop fingerprint patterns.

**Keywords**: Latent fingerprint, natural powder, and purple sweet potato

## Introduction

Forensic identification is an effort made with the aim of helping investigators determine a person's identity. Determination of the identity of the victim as well as the determination of the identity of the suspect of the crime is the most important part of the investigation. Identification can be done in three ways: visual (relatives or acquaintances seeing the body); detailed data (for example, ante-mortem data that matches the information collected during autopsy and other situational information) and scientifically or objectively (for example, dental examination, fingerprints, or DNA). Identification is not absolute based on the order above; if the continuation of the identification process becomes more difficult, the next method is taken. Where possible, visual identification must be supplemented by one of two other methods[1]. Some of the materials used as a way to find out fingerprints are chemicals which always potentially toxic and harmful to health. To overcome this, several studies have been carried out to use natural powders as the development of latent fingerprints that are easily obtained, non-toxic and many properties (Sari, 2019a). Therefore, this study was conducted a visualization study of latent fingerprints using purple sweet potato. The simplest way to identify fingerprints was to use a dusting fingerprint method. This method was used if the suspect's fingerprints are visible to the naked eye or commonly called "visible fingerprints"[2].

Identification of latent fingerprints using the powder method using natural ingredients has previously been done by several researchers. A study conducted a visualization study of latent fingerprints using herbal ingredients namely turmeric (Curcuma longa)[3]. It also has been identified latent fingerprints with gambir powder, the result of good visualization of the powder method carried out at sizes 100 and 200 mesh[4]. A finding from study on visualizing latent fingerprints using rangoli coloring was in each development on various media differed in the time of development. Initially after drying the sample is good on every surface but then on the ridge it is not clear depending on the surface. Obviously every mold developed is of good quality and easy to analyze[5]. A new technique used to visualize latent fingerprints by the method of powder pulverization on various surfaces. Visualization using turmeric powder from herbal plants (Curcuma longa), turmeric powder used as the development of latent fingerprint visualization provides contrast printing on the surface and gives good results for developing latent fingerprints[6].

Therefore, this study was carried out using purple sweet potato powder due to it has a contrasting color as a natural coloring agent. Purple sweet potato is one type of sweet potato that is commonly found in Indonesia besides the white, yellow, and purple ones[7]. Purple sweet potato of Ipomoea batatas L. Poir has a fairly deep purple color on the flesh of the sweet potato, so it attracts a lot of attention. The purple color in sweet potatoes is caused by the presence of anthocyanin purple pigments that spread from the skin to the flesh of the sweet potato. This anthocyanin concentration causes several types of purple sweet potatoes to have different shades of purple[8]. Based on the background mentioned above, then the problem formulation in this study was how to develop purple sweet potato powder method as a visualization of latent fingerprints on porous and non-porous surfaces? The benefit of this research was as an alternative material to identify latent fingerprints from tubers and non-toxic.

## Literature Review

### *Fingerprints*

Fingerprints are actually thickened and thinned skin forming a "ridge" on the palm of a finger that forms a patter. Fingerprints will not disappear until a person dies and rot, scratches or cuts usually when the skin changes will form the same pattern, however fingerprints can be damaged because the skin is affected by severe burns[9]. Fingerprints are a unique thing given by God to every human being[10]. Everyone's fingerprints will be different and never the same. This makes fingerprints often used in biometric technology. Another advantage of fingerprints is the practicality and durability. Fingerprint is the result of printing fingerprints, either taken, dipped in ink, or used marks left on an object because it was once touched with the skin of the palm of the hand or foot[11].

Latent fingerprints are deposits of water, fat, and the results of secretions on a surface. Latent fingerprints are invisible even though there are actually fingerprint patterns on the surface. Therefore it is necessary to have a material or compound that is able to visualize latent fingerprints so that fingerprint strokes are clearly visible on a surface. Many materials can be used to visualize latent fingerprints, but the material used is adapted to the conditions or shape of the surface on which latent fingerprints are attached[12]. Characteristics of fingerprints used are fingerprint strokes that can be identified by analyzing the details of fingerprint strokes called "minutiae". The characteristics of the fingerprint pattern can be in the form of curvature, number of lines, feature vectors, *etc.*[13].

The fingerprint distortion was divided into five categories, namely: oily, dry, dirty, partially cut off, and rotation). The researcher reexamined the type of image quality distortion (dry, oily, dirty, and neutral). In general, fingerprint quality depends on ridge cleanliness/ clarity separated by valley. A fingerprint image can change due to several reasons by environmental conditions, such as temperature, humidity and pressure[14]. Fingerprint quality depended on the condition of the skin[15]. A study of fingerprint visualization based on sex and blood type, loops were the most commonly found fingerprint patterns and arches[16].

The simplest way to remove fingerprints is by dusting (powder sprinkling). This method is usually used on latent or visible fingerprints with the naked eye. Latent fingerprints usually stick to aluminum plates, paper, or wood surfaces. If any mold appears, they are photographed and then removed from the surface with adhesive tape. Revocation of the recording is then placed on a latent lift card to preserve print[17]. The working principle of finger picking is the interaction or attachment of the powder mechanically with the latent fingerprint component (water and fat) on a surface. The mechanism for attaching powder to a fingerprint can occur through two mechanisms. The first mechanism, the attachment of the powder base material is inert to fingerprint fat deposits. The second mechanism is the process of dissolving fingerprint deposit components with certain compounds to produce color changes[18].

*Purple Sweet Potato*

Purple sweet potato powder (Ipomoea Batatas L. Poiret) is shown in Figure 1.

**Figure 1**. Purple sweet potato

Purple sweet potato is one type of sweet potato that has received a lot of attention lately. Purple sweet potato has skins and flesh of tubers that are blackish purple (deep purple) and reddish purple caused by anthocyanin pigments[19]. Anthocyanin in purple sweet potato has antioxidant activity. The difference in antioxidant activity in red and red sweet potatoes is in the type of color. In red sweet potato found dominant is pelargonidin-3-routineoside-5-glucoside type, while in purple sweet potato is anthocyanin and peonidin glycoside which have stronger antioxidant activity.

Thus, purple sweet potato has great potential as a source of natural antioxidants and at the same time as a natural purple dye. Anthocyanin is water soluble and safe for consumption, so it is generally used as a natural coloring for food and beverage products[20]. Purple sweet potato also functions as an antioxidant and free radical scavenger because it has high anthocinin. Besides anthocyanin plays a role in preventing premature aging and degenerative diseases such as atherosclerosis and cancer. Anthocyanins in purple sweet potato also act as antimutagenic and anticarcinogenic, prevent interference with liver function, anti-hypertension, reduce blood sugar levels and total blood cholesterol, improve memory, anti-inflammation and anti-microbial[21]. Purple pigment in purple sweet potato (anthocyanin) which will react with sweat so that the results of the latent fingerprint visualization with this powder method are purple. Figure 2 is a reaction between anthocyanin compounds in purple sweet potato with amino acids found in sweat.

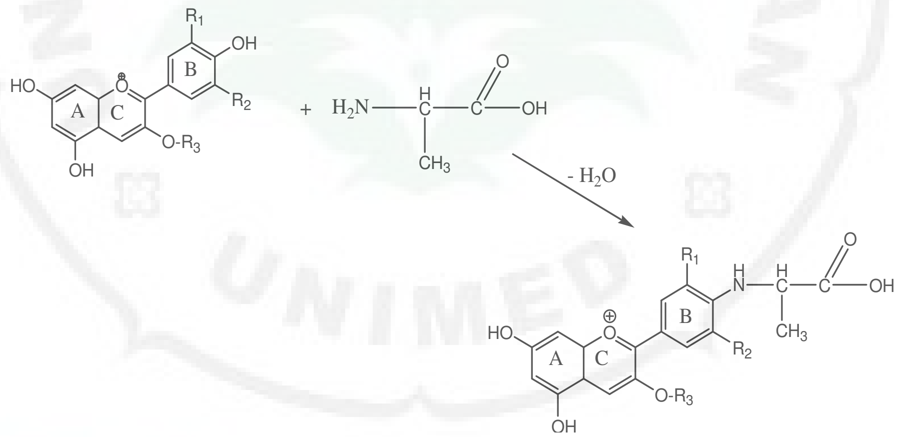


**Figure 2**. The reaction between anthocyanin and alanine

## Experimental

This research was conducted at the North Sumatra Police Directorate General of Criminal Sciences Laboratory (INAFIS) Medan, North Sumatera, Indonesia.

### *Tools and Materials*

The tools used in this study were: lumping and pestle, sieve (Sieve Stell), powder container (GM), bottle bottle, feather duster (sirchie), ballpoint (standard), gloves (sensi), white A4 paper (white paper) paper one), measuring flask (Iwaki), watch glass (Iwaki), beaker glass (Iwaki), measuring cup (Iwaki), and magnifying glass (Joy-Art). While the materials used are purple sweet potato, aluminum foil (Dzworld), plastic cups, compact disks (Sony), and transparent plastic sheets (Doremi).

### *Population and Research Samples*

The population of this study was all students of the Department of Chemistry, Chemistry Study Program, Medan State University. Latent fingerprint samples were tested come from several individuals those who had the following criteria: i) several terms; ii) the blood type of chemistry study program students were from 2016 to 2018 intakes.

### *Development of Latent Fingerprints with the Powder Method*

Latent fingerprints were prepared on each porous surface (white A4 paper) and non-porous surface (aluminum foil, glass cup, plastic cup, transparent plastic sheet, CD surface). Each fingerprint was applied a little purple sweet potato powder with a brush. Using a unidirectional pattern, wipe the brush over the mold so that latent print has appeared on the surface of the object.

### *Making Purple Sweet Potato Powder*

A total of 500 grams of sweet potato powder was selected and washed, then peeled and cut into small pieces. Then it was dried at room temperature for 2 days and blended until smooth with sizes 60, 80,100 and 200 mesh. After that, purple sweet potato powder was sifted and placed in a powder container (Rezki, *et al*., 2015).

### *Latent Fingerprint Preparation & Examination*

The method used was latent fingerprints prepared on each porous surface (white A4 paper) and surfaces that are non-porous (aluminum foil, glass cup, plastic cup, transparent plastic sheet, CD surface). The results of the development of latent fingerprints that have been seen, checked by identification manually and using a magnifying glass to determine the shape of the fingerprints formed, print contrast on the surface, the resistance of the test material to the length of the test time[22].

## Results and Discussion

### *Preparation of Purple Sweet Potato Powder*

A 1 kg of purple sweet potatoes was selected and washed thoroughly. Then the skin was peeled and sliced into small pieces. Then dried in the room at room temperature or aerated for three days. After drying, it was mashed to produce purple sweet potato powder. Purple sweet potato powder was sieved with a size of 60, 80, 100 and 200 mesh and then placed in each container. This is shown in Figure 3.

(a) (b) (c) (d)

**Figure 3.** Purple sweet potato powder from the sieve: (a) 60; (b) 80; (c) 100 and (d) 200 mesh

The results of the purple sweet potato powder sieve were physically brownish-purple, 200-100-mesh sweet potato powder was very fine. Purple sweet potato powder size 80 was quite smooth. Another thing on the 60 mesh powder sieve was a little rough. Purple sweet potato powder in the container was put silica to keep it dry and odorless. Drying was not done in the sun or oven because drying in the oven can occur biochemical changes, thereby reducing the quality of the product to be produced. Meanwhile, if drying with sunlight will cause damage to the chemical content of the dried material[23].

***Results of Development of Purple Sweet Potato Powder Method***

Fingerprints containing sweat were printed on each surface of the media that has been provided and then developed with the purple potato powder method. The powder method was done by applying the sweet potato powder evenly on a sweat-filled surface. To collect sweat prints, subjects were first asked the right thumb to touch the scalp and rub it. So that, sweat could be applied to the fingers and applied to various subtractions/surfaces[24]. Visualization results of latent fingerprints that were good with the application of powder to the mold by brushing techniques easily and simply using a brush. The brush polishes purple sweet potato powder slowly and in a direction so as not to damage the ridge/line characteristics of the fingerprint[25].

***Analysis of Latent Fingerprints based on Differences in Mesh Size***

The development of latent fingerprints using purple sweet potato powder was not all clearly visible. Because the latent fingerprint visualization uses the powder with a variety of mesh sizes namely 60, 80, 100 and 200 mesh. The difference using several mesh sizes is shown in Figure 3 below:

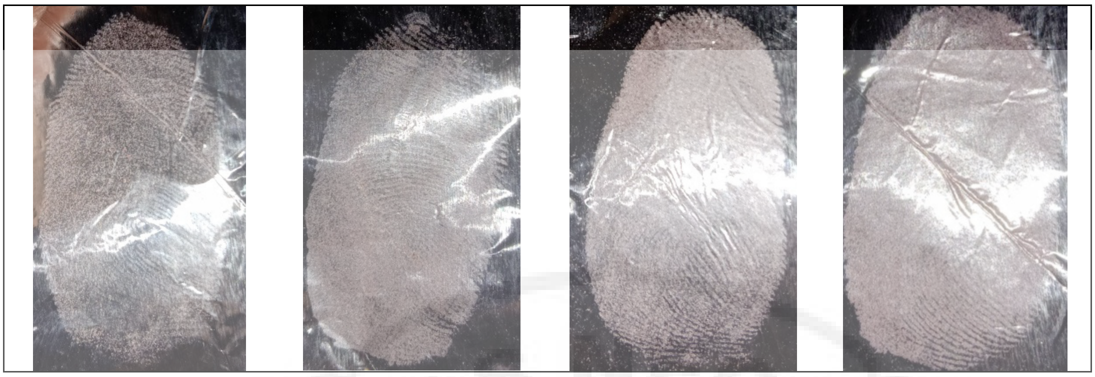
(a) (b) (c) (d)

**Figure 3.** Visualization of latent fingerprints using purple sweet potato powder on aluminum foil at sizes: (a) 60; (b) 80; (c) 100 and (d) 200 mesh.

Figure 3 shows the results of the latent fingerprint visualization using purple sweet potato powder. Smaller powder particles would have better adhesion ability than larger particle sizes. Figures 3(c) and 3(d) were the result of visualization of latent fingerprints with powder sizes of 100 and 200 mesh forming an ulnair loop pattern. A visualization study of latent fingerprints using a mixture of silica gel (primary) and hydrated magnesium silicate (minor) and briliant blue R, the particle size used as a powder was 100-200 mesh[26]. It has been examined that nano particle size with particle size from 400-500 nm and powder micro particles with particle size around 27 μm can be used as fingerprint development powder[27]. Anthocyanins in the sweet purple potato that react with alanine caused visualization of the latent purple fingerprints in the purple powder method. The anthocyanin reaction with alanine is shown in Figure 4.

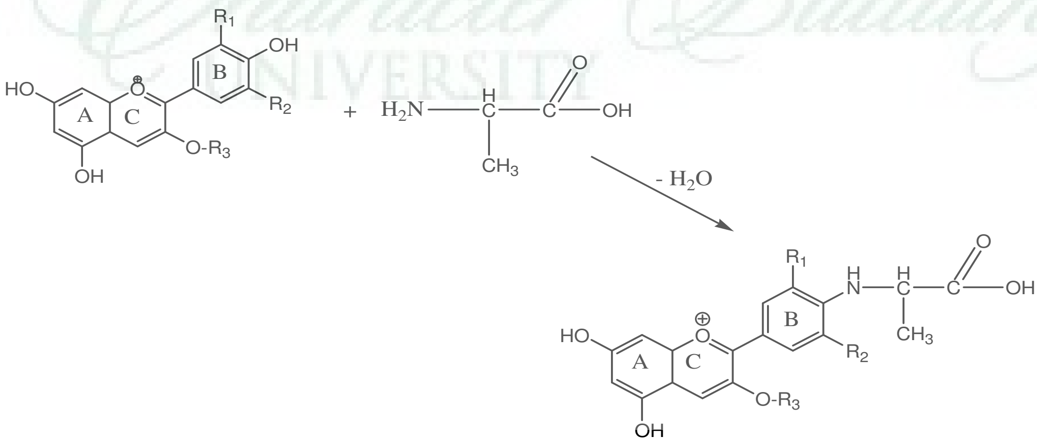


**Figure 4**. The reaction between Anthocyanin and the amino acid alanine

Anthocyanins act with the amino acid alanine which produces a purple color from anthocyanin to purple on fingerprints because alanine electrons attack the tertiary carbon in anthocyanins.

*Latent Fingerprint Analysis Based on Media Surface*

Development of latent fingerprints using purple sweet potato powder on various development media, namely non-porous surfaces (transparent plastic, plastic cups, aluminum foil and compact disks) and porous (white paper). Visualization of latent fingerprints identified using 120 samples. Intake using purposive sampling method that was sampling using certain considerations[28]. Figure 5 visualization of latent fingerprints using purple sweet potato powder on aluminum foil compared to plastic cups, transparent plastics and compact disks (CD).

(a) (b) (c)

**Figure 5**. Comparison of visualization of latent fingerprints using purple powder on aluminum foil with: (a) plastic cups; (b) transparent plastic, and (c) compact disk.

Figure 5(a) was the latent fingerprint on aluminum foil (left) compared to the latent fingerprint that has been visualized on a plastic cup (right). Figure 5(b) was the latent fingerprint on aluminum foil (left) compared to the fingerprint on (transparent plastic). Figure 5(c) was a latent fingerprint on aluminum foil (left) compared to a compact disk (CD). The result of a good surface comparison in visualizing latent fingerprints was on the surface of aluminum foil and CD.

Figure 6 shows the visualization of latent fingerprints using purple sweet potato powder on plastic cups compared to transparent plastic, CDs and white paper.

(a) (b) (c)

**Figure 6.** Comparison of visualization of latent fingerprints using purple potato powder on plastic cups with: (a) transparent plastic; (b) CD; and (c) white paper.

Figure 7 shows the visualization of latent fingerprints using purple sweet potato powder on transparent plastic compared to CDs, white paper and aluminum foil.

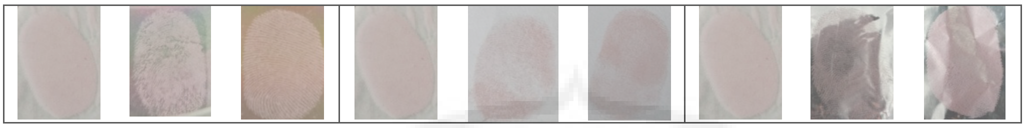
(a) (b) (c)

**Figure 7**. Comparison of visualization of latent fingerprints using purple otato powder on transparent plastic: (a) CD; (b) white paper and (c) aluminum foil.

Figure 8 shows visualization of latent fingerprints using purple sweet potato powder on a CD compared to white paper, aluminum foil and plastic cups.


(a) (b) (c)

**Figure 8.** Comparison of visualization of latent fingerprints using purple potato powder on a CD with: (a) white paper; (b) aluminum foil and (c) plastic cups.

Figure 9 shows the latent fingerprint visualization using purple sweet potato powder on white paper compared to aluminum foil, plastic cups and transparent plastic.


(a) (b) (c)

**Figure 9**. Comparison of visualization of latent fingerprints using sweet purple potato powder on white paper with: (a) aluminum foil; (b) plastic cups and (c) transparent plastic.

Based on Figure 5 to 9, the latent fingerprints developed by the method of purple sweet potato seed was declared successful. This was based on the results of the development of latent fingerprints showing ridge characteristics/lines on each surface. Some visualization of latent fingerprints was not very clear due to the lack of characteristic sebum or sweat contained in the substrate and the surface of the substrate used. White paper ridge printing was less visible due to the porous surface so that the mold is absorbed quickly down the surface. Therefore, after sebum was printed, it was directly developed with purple sweet potato powder so that the ridge characteristics are clearly visible.

This findings was in line with some previous studies. A research on the development of latent fingerprints using turmeric powder on 6 surfaces namely: glass preparations, aluminum foil, transparent plastics, CDs, plastic cups and transparent plastics only 4 from the surface which gave good ridge characteristics. Plastic cups and transparent plastic were not good due to the difficulty level of printing fingerprints on media with smooth and cylindrical surfaces[2]. It also has been examined that the development of latent fingerprints depends on the type of powder and the type of surface of the fingerprint visualized. It was examined the development of latent fingerprints depending on the powder used, the surface on which the mold was placed and the type of latent mold deposited (sweat and sebum)[4 & 29].

***Latent Fingerprint Analysis Based on Ethnicity and Blood Type***

Latent fingerprint development was carried out using 120 samples. Fingerprints were divided into three tribes and four blood groups, namely the Batak, Javanese and Malay ethnic groups. Each tribe has ten people with blood type A, B, AB and 0. The percentage of fingerprint patterns formed by the purple potato powder method is shown in Table 1. Based on Table 1 shows that of the 120 samples had the highest percentage in the ulnair loop fingerprint pattern and plain whorl in the second sequence. Batak tribe 70 percent ulnair loop fingerprint pattern in blood group A, 50 percent in blood group AB and 60 percent in blood group 0. This means that ulnair loop pattern was very dominant in the Batak tribe. This was consistent with Sari's research[2] which stated that from 30 fingerprint samples had the highest percentage in the 70 percent ulnair loop fingerprint pattern on the Batak tribe. It might be due Hall[30] that the ulnair loop pattern was the basic pattern of human fingerprints, but there are several genes that play a role in fingerprint formation so that the pattern experiences many variations.

**Table 1**. Percentage of fingerprint patterns with purple potato powder

| Pattern (%) | Tribe/Blood Type | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Batak | | | | Javanese | | | | Malay | | | |
| | A | B | AB | 0 | A | B | AB | 0 | A | B | AB | 0 |
| Radial loop | 1 | | 1 | 1 | | 2 | 2 | 2 | 1 | 3 | 2 | 2 |
| Ulnair loop | 7 | 4 | 5 | 4 | 7 | 4 | 5 | 5 | 2 | 4 | 4 | 5 |
| Plain whorl | 2 | 6 | 4 | 4 | 3 | 4 | 3 | 3 | 7 | 3 | 3 | 3 |
| Twinted loop | | | | 1 | | | | | | | | |
| Tented arch | | | | | | | | | | | 1 | |
| **Total** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** |

Javanese ulnair loop pattern is highest in blood type A 70 percent, and blood type 0 50 percent. This shows that in Javanese terms the loop pattern was also the most dominant. Therefore according to Sari[4] which stated the highest loop fingerprint pattern in Javanese. The dominant Javanese loop fingerprint pattern, then in the next sequence whorl and arch[31].

Based on the data in Table 1, the finger pattern of each syllable of the most dominant is the loop pattern. Blood group O was associated with more loops and fewer whorls than blood groups A[32]. The study reported that high frequency loops with moderate whorls and low curvature in individual A, B and O blood groups[33]. The distribution of the main fingerprint patterns is the same for different ABO blood groups (A, B, AB and O): the loop has the highest percentage, followed by a coil and the least was the arch[34] Research has also reported a significant relationship between fingerprint patterns and blood groups[35]. In contrast, it has been reported that there was no significant relationship between thumb print patterns and A, B, O blood groups[36].

## Conclusions

The development of latent fingerprints using sweet purple potato powder was done by slowly applying the powder assault. Then a fingerprint pattern was formed. The results of this study indicated that fingerprints obtained from 120 samples were 11.6% radial loop, 44.1% ulnair loop plain whorl 33.3% twinted loop and tented arch 0.8%. In this method visualization was clearly visible on the surface of aluminum foil and CD. The results of the determination of latent fingerprint visualization between tribes and blood groups were the most common patterns found are ulnair loop fingerprint patterns.

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