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An Observational Study on Possible Evidences Available from Nail Clippings

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Abstract

The aim of this analysis centers on recognition of contaminants which relates to the possible profession of the accused thereby tapering the list of suspects. Certain samples were studied and analyzed microscopically in 40X and these sample providers singled out the contaminants on the basis of preliminary information. This aids in forensic investigation to identify bodies. Pivoting on the detection of the nail clippings, this study is both confirmatory and conclusive. All the collected samples were collected under hygienic conditions, and were heterogeneous with a wide class of age groups. In the cases of participants who were unable to read and write, the consent was described and then the permission was confiscated. To ensure the contamination and error during collection, the procedure was conducted on the basis of standard operating procedures.

Keywords: Nail clippings, Nail samples, Microscopy, Carpenter, plumber, Microscopy, constructors, Mechanics, Gardner, Tailor, Teacher, Painting, Laundry, Animal husbandry, Oil store.

Introduction

In crime scene investigation, physical evidence has always played a chief role. To determine the individuality of a person, nails play a prime role. The study of nails from toes and fingers leading to a superior administration of justice in the courtroom is called forensic onychology.

The nail can be used for sample sizing or to compare it with other tissues. With each nail we can receive an individual documentation of comprehensive information about genetic inheritance, location, work diseases, pathology, diet etc. The decomposition level of nails is comparatively well than the soft tissues. In crime scene investigations, nails amongst many biological evidence found on the crime scene are used as possible valuable evidence. The particular reason for this is that the nails can survive under extreme environmental conditions

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and even with small aggregate, it can be easily examined, since the chemical composition of nail remains same, it helps in personal identification of suspects.

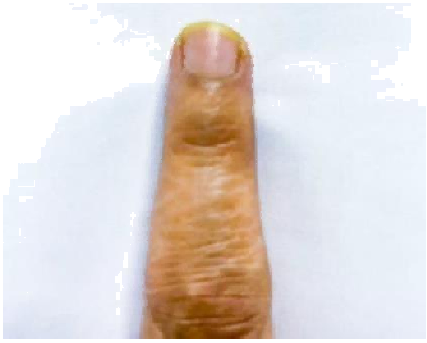

Figure 1: Finger nail

Nail Anatomy

All animals have nails at the tip of toes and fingers as their characteristic feature. Nail is more like a claw plate on fingers and toes. A polymer, alpha keratin forms the nail as tough and protective layer. This alpha keratin is generally observed in horns and hooves of vertebrates.

Parts of nails

A matrix also known as germinal matrix is responsible for generating the cells. It is also called as nail matrix, matrix unguis, keratogenous membrane and onychostroma and is considered as the active tissue of the nail. The cells so formed starts to harden as they are directed from the nail root towards the nail plate. The thickness and the length of the matrix and the size determines how thick and wide would the nail plate be and whether the nail plate will be hooked, flat or arched, will be determined by the shape of the finger bone.

Nails are said to be the highly keratinized structures that are infoldings of distal part of the epidermis layer. These are projected outward of the skin. Nails are skin appendages that are composed of specialized cells known as oncocytes which carry a high amount of fibrous protein. Nails are composed of keratin, water, proteins, minerals and lipids.

During the course of conduction of any activity or any other work certain chemicals, biological materials or drugs get accumulated in the nails. These nails if collected, can give us information about personal identification of the type of work they had been doing lately or their involvement was in which kind of profession. The information on whether the person was undergoing any medications or drugs or they had certain genetic inheritance or diseases can also be predicted.

Function

The function of the fingernail is to protect the fingertip, the distal phalanx and the soft tissues from any damage or injuries. The pulp of the finger undergoes a counter pressure that amplify the movement of digital digits. When the tip of the finger meddle with any object, the nail

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acts as a counter force and intensify the sensitivity of the fingertip, even when nail lacks nerve endings. Nail can perform certain actions like scraping, cutting, and gripping as well.

Growth

The part of the nail which grows is the only living part of the nail which is at proximal end of the nail under epidermis, underneath the skin. The growth of nail of the little finger is slower than that of the nail of index finger. The growth of finger nails is four times more than toe nails. This is because the growth rate and length of terminal phalanges are closely related in mammals.

The average growth rate of human finger nails is approximately 3.55 mm a month and the average growth rate of human toe nails is approximately 1.6 mm a month, that is about half of growth rate of finger nails. They need twelve to eighteen months to regrow completely whereas finger nails develop completely in three to six months. The attested growth rate is conditional of factors like sex, season, age, diet, exercise level and heredity. After death, the skin tightens and dehydrates, this is why nails appear to grow and do not grow in reality.

Permeability

The nail is very permeable contradicting the fact of it being an impermeable barrier. It contains 7-12% of water. Because of the nail being permeable many medicinal as well as harmful substances penetrate inside, and any cosmetic application can create risk on nails. Along with water many other materials like paraquat, herbicides that are quick in action and are injurious to humans, creams and body lotions that has urea as an ingredient, many fungicidal agents like salicylic acid, sodium hypochlorite used in bleach and miconazole branded Monistat and natamycin.

Health and Care

Trimming regularly is the best care of nails for preventing nails from becoming rough, and for eliminating other ridges and bumps, filing is also advised, so that nails do not get tangled.

If the bed of the finger nail appears bluish or purple, it is indicative of peripheral cyanosis that shows oxygen deprivation.

Nails, just like skin get desiccated, peeled off, get infected or broken down for example, toe infection can be brought about by dirty socks, or certain kinds of exercises which are aggressive, usage of tight footwear, exposure to unclean environment, certain organisms like dermatophytes, moulds and yeasts can also cause nail infections.

Fashion

Manicures are certain cosmetic and health procedures for hands to trim, groom, paint the nails and manage calluses. These procedures, require a variety of tools such as nail scissors, nail clippers, cuticle scissors and nail files. People also fix artificial nails over real nails for purposes of fashion.

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Materials and Method

Specimen Collection

About 400 nail clipping samples were obtained from people belonging to different profession, age group and work place and those samples were analysed. Out of these samples, 289 samples were carrying impurities.

Sample Size

The range of age groups from which these 400 nail clipping samples were collected was from 18 years to 60 years of age, and based on certain parameters these samples were segregated. On segregating the samples based on gender, it was found that males and females contributed equally towards these 400 samples.

Sample Population

Inclusion criteria: Healthy adults those who have no systemic abnormalities or disease or local disease which will not interfere in the nail's growth.

Exclusion criteria: Nail biting habits and manicure.

The samples of nail clippings were collected by the volunteers themselves with the help of nail clippers and packed in plastic zip lock bags and were stored for analysis in room temperature.

Collection method

For collection, either scissors or nail clippers are used and they should be cleaned before using. The individuals were asked to cut the nail as closed to the bed as possible according to the comfort on a clean paper sheet. 2-4 mm sample was collected from each digit.

1.9.5 Sample storage

The clippings were transferred in a clean plastic zip lock bags and were packed to avoid contamination and prevent the entry of air to enhance the microscopic study. The clippings obtained should not be refrigerated or frozen and must be stored in normal and dry room temperature.

Sample Labelling

The serial number, name and occupation are assigned to the samples upon the zip lock bags with the help of markers so as to assist identification and observation according to occupation.

Consent form

Before the collection of the sample, consent was taken from each volunteer to donate their clipping for a study.

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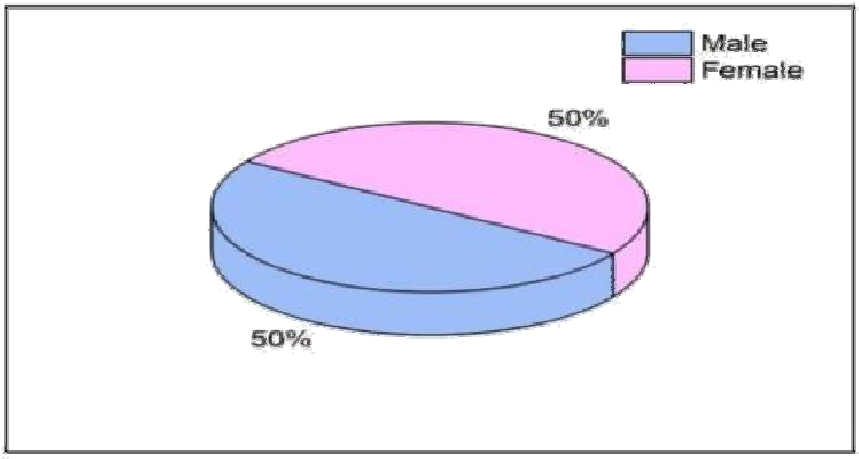
Sample observation

Sample examination time: To receive proper results in observation, samples were evaluated within 24 hours of collection.

Microscopic examination: Compound microscope was used for the observation of samples. With the help of forceps, nail samples were placed on clean and sanitized microscopic slides. Observation was carried on under 10X.



Graph 1: Pie chart indicating male and female sample percentage

Figure 3(a): cloth Fibers

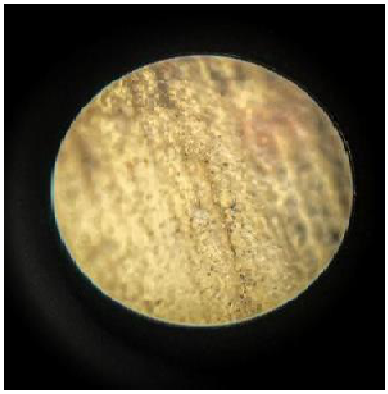


Figure 3(b): Dust particles

Figure 3(c): Blood

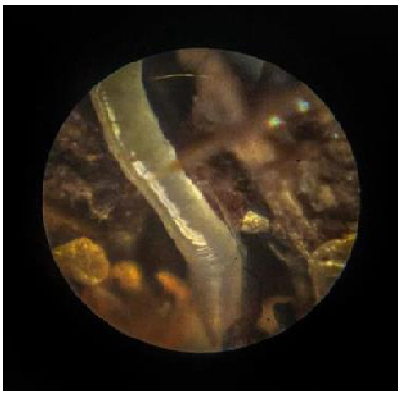


Figure 3(d): Mud particles

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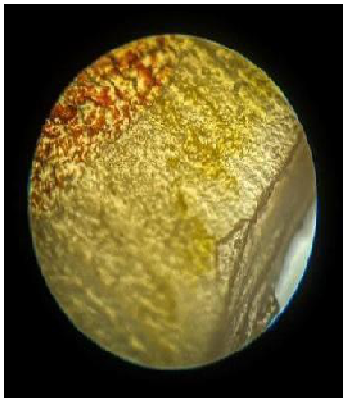

Figure 3(e): Blood

Figure 3(f): Dust particles

Figure 3(g): Dirt particles

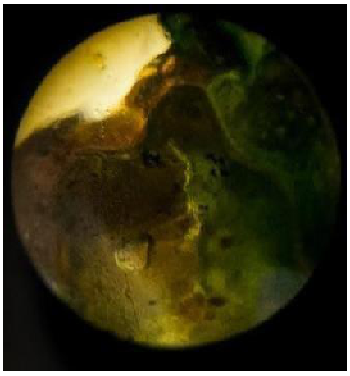

Figure 3(h): Algae

Figure 3(i): Dye

Figure 3(j): Animal Dung

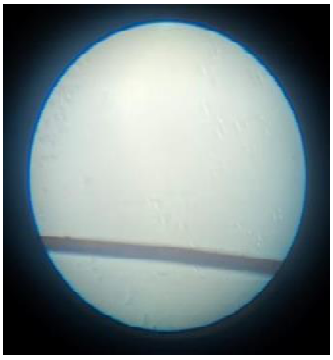

Figure 3(k): Hair

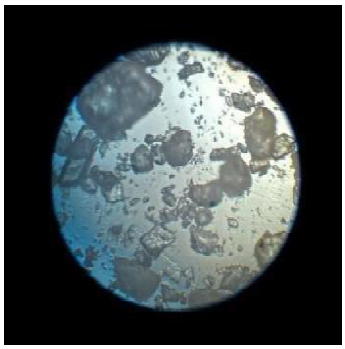

Figure 3(l): Chalk powder

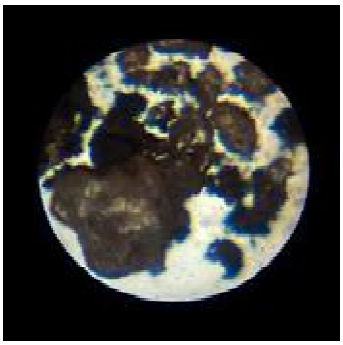

Figure 3(m): Ashes

Figure 3(n): Dust

Figure 3(o): Cement particles

Figure 3(p): Machine oil

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Figure 3(q): Dye

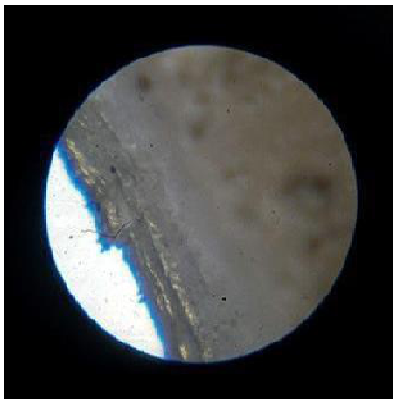

Figure 3 (r): Dirt

Table 1: Total number of samples collected in each category and segregated on the basis of gender

SI Number	Occupation	Number of People	Males	Females
1	Construction	52	20	32
2	Animal husbandry	33	18	15
3	Agriculture	40	13	27
4	Gardeners	20	15	5
5	Tailors & Garments	20	3	17
6	Laundry	13	4	9
7	Salon	16	11	5
8	Parlors	24	2	22
9	Health care	16	1	15
10	Teachers	22	2	20
11	Petrol bunk	19	11	8
12	Cooks	9	2	7
13	Painting	26	24	2
14	Carpenters	11	10	1
15	Oil store	15	3	12
16	Plumbers	10	8	2
17	Mechanics	54	53	1

The table represents the samples that were collected from all the categories and were separated on the basis of gender. A total of 400 samples are shown in the table out of which 200 samples are from male and 200 from females.

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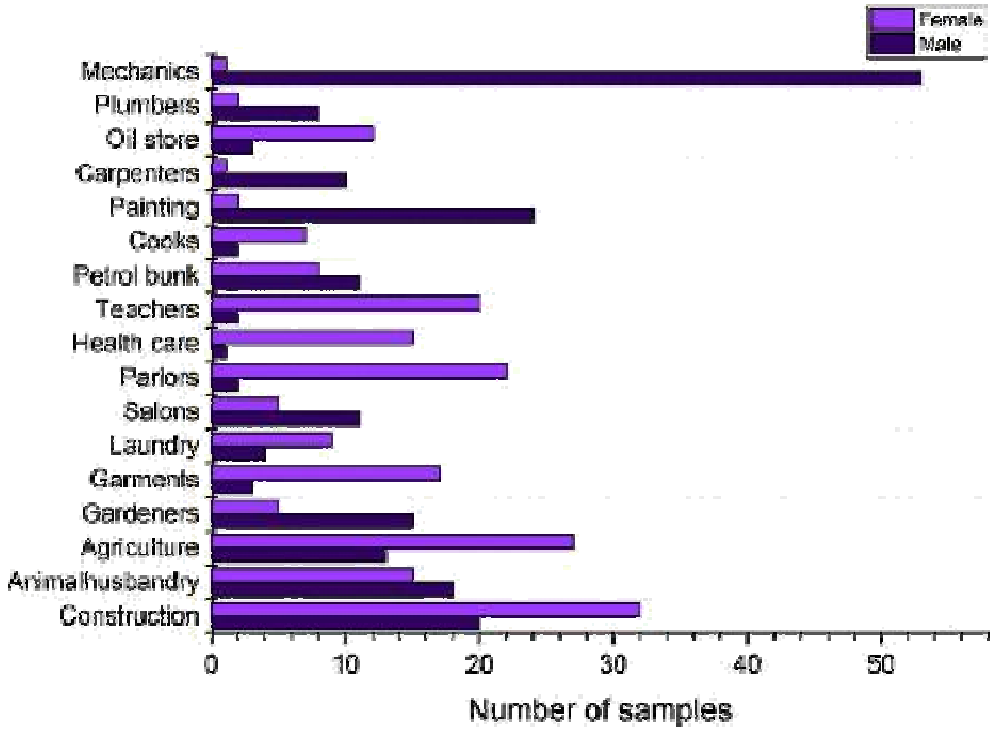

Graph 2: Bar graph representing number of male and female samples

All the 400 volunteers belonged to the age group between 18-60 years of age and after segregating the samples on the basis of gender they were segregated on the basis of other parameters and it was found that in 400 samples male and female samples contributed equally.

Results and Discussion

The contemporary study is about the occurrence of exchange traces that is based on Locard's principle of exchange that says, the person who is committing a crime, will get something on the crime scene which will be left there and will take something from the crime scene.

To explore the presence of this principle in today's world which is authenticated by diverse industriousness, various nail clippings belonging to different work places were collected from people who belonged to different age groups and were associated with different lifestyle and profession. Amongst the 400 samples that were collected, 289 samples were adulterated with impurities like cement, mud, dirt, dye, hair, oil, kerosene, paint etc.

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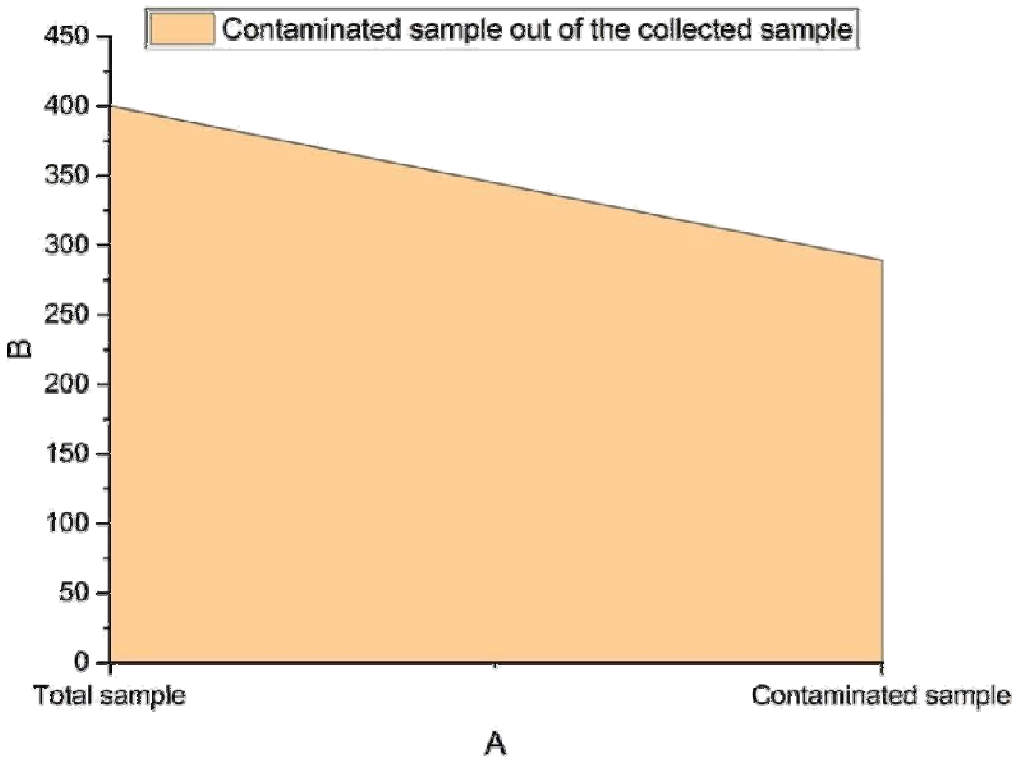
Table 2: Total number of samples collected in each category and the number of evidences found

SI Number	Occupation	Number of People	No of Evidence
1	Construction	52	46
2	Animal husbandry	33	26
3	Agriculture	40	31
4	Gardeners	20	16
5	Tailors & Garments	20	12
6	Cleanness/Laundry	13	2
7	Salon	16	7
8	Parlors	24	13
9	Health care workers	16	7
10	Teachers	22	13
11	Petrol bunk	19	16
12	Cooks	9	2
13	Painters	26	23
14	Carpenters	11	7
15	Oil store	15	12
16	Plumbers	10	7
17	Mechanics	54	49

Amongst the 200 male samples and 200 female samples, (total of 400 samples) 289 evidences were found.



Graph 3: Area graph representing number of contaminated samples out of the total number of collected sample

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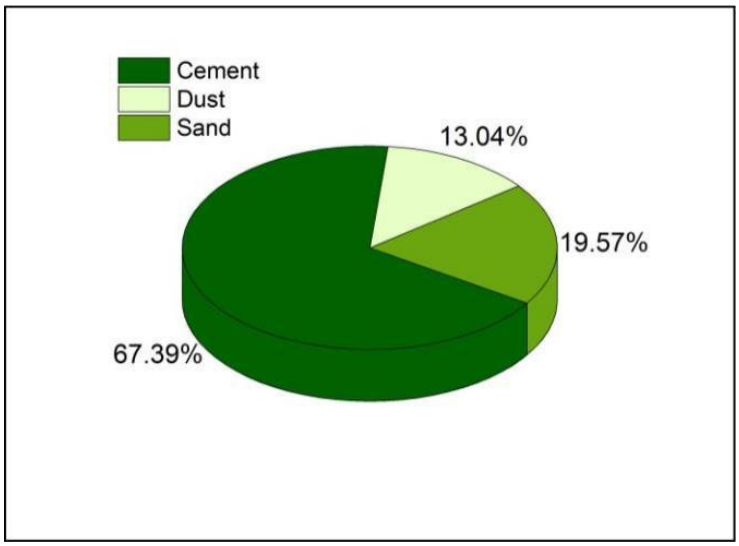
The samples that were obtained were from people belonging to different professions and were analysed and out of 400 samples, 289 samples were adulterated with impurities.

Table 3: Total number of nail clipping samples collected and different kinds of evidences found under observation

SI Number	Occupation	Number of People	No of Evidence	Particles found
1	Construction	52	46	Cement, dust, sand
2	Animal husbandry	23	26	Animal dungs, dirt, hair
3	Agriculture	40	31	Mud, Urea, plant residue, algae
4	Gardeners	20	16	Mud, plant residue, algae
5	Tailors & Garments	20	12	Dirt, fiber fragments, dust
6	Cleanness/Laundry	13	2	Soap, Washing powder
7	Salon	16	7	Sperm, Dye, Hairs
8	Parlors	24	13	Cosmetics, dirt
9	Health care workers	16	7	Soap, dirt, detergents
10	Teachers	22	13	Chalk piece, markers residue
11	Petrol bunk	19	16	Oil
12	Cooks	9	2	Salt, oil
13	Painters	26	23	Paint, Tinner, dirt
14	Carpenters	11	7	Gum, wooden dust, dirt
15	Oil store	15	12	oil
16	Plumbers	10	7	Gum, dirt, Blood
17	Mechanics	54	49	Black oil, dirt

Table represents the total nail clippings that were gathered and the kinds of evidences like hair, dye, mud, paint, oil, dirt, kerosene that were found in the 400 samples.



Graph 4(a): Analysis of various components obtained nail clippings collected from construction sites

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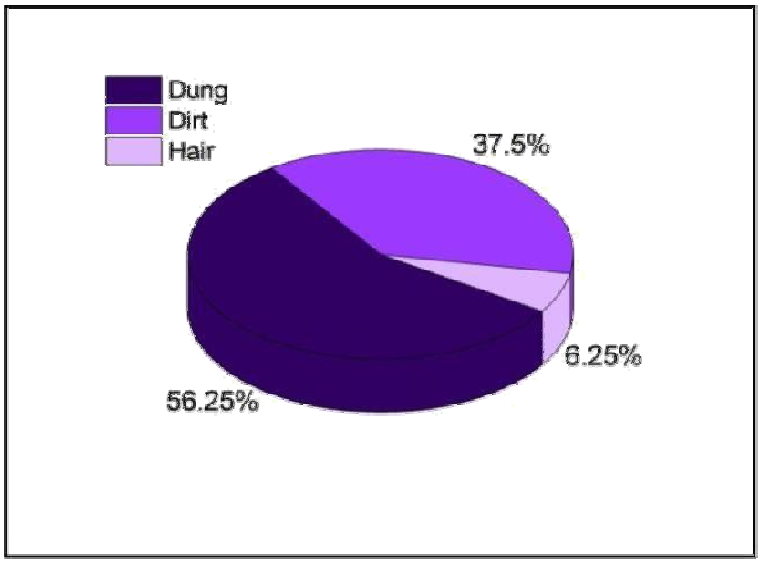
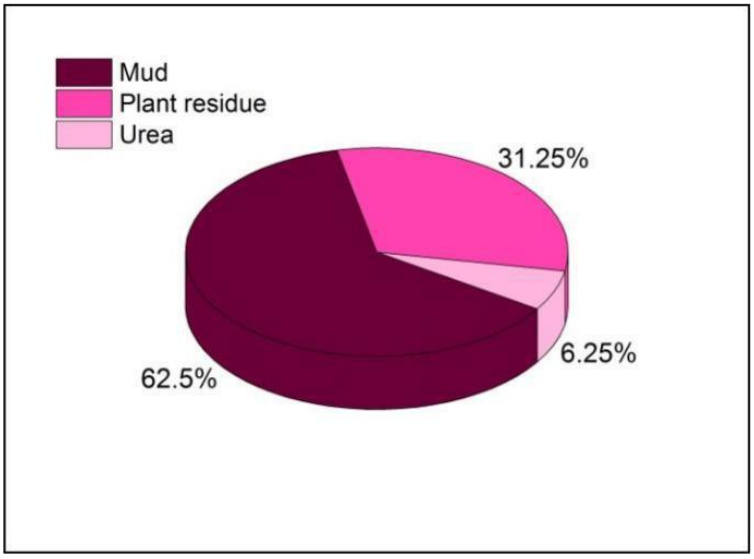
Pie chart depicting 46 contaminated samples out of 52 samples collected from people working in various construction sites. Out of 46 contaminated samples 67.39% contained cement, 19.57% contained sand and 13.04% contained dust.



Graph 4(b): Analysis of various components obtained nail clippings collected from Animal husbandry workers

Pie chart depicting 26 contaminated samples out of 33 samples collected from people working in various Animal husbandry. Out of 3 contaminated samples 56.25% contained dung, 37.5% contained dirt and 6.25% contained Hair.



Graph 4(c): Analysis of various components obtained nail clippings collected from Agricultural workers

Pie chart depicting 32 contaminated samples out of 40 samples collected from people working in various Agricultural workers. Out of 32 contaminated samples 62.5% contained mud, 31.25% contained plant residue and 6.25% contained urea.

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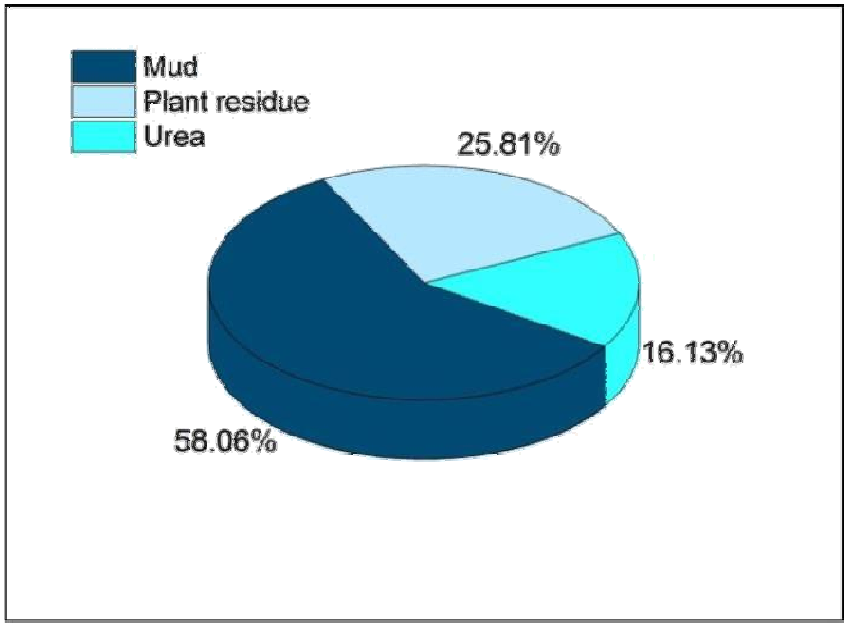
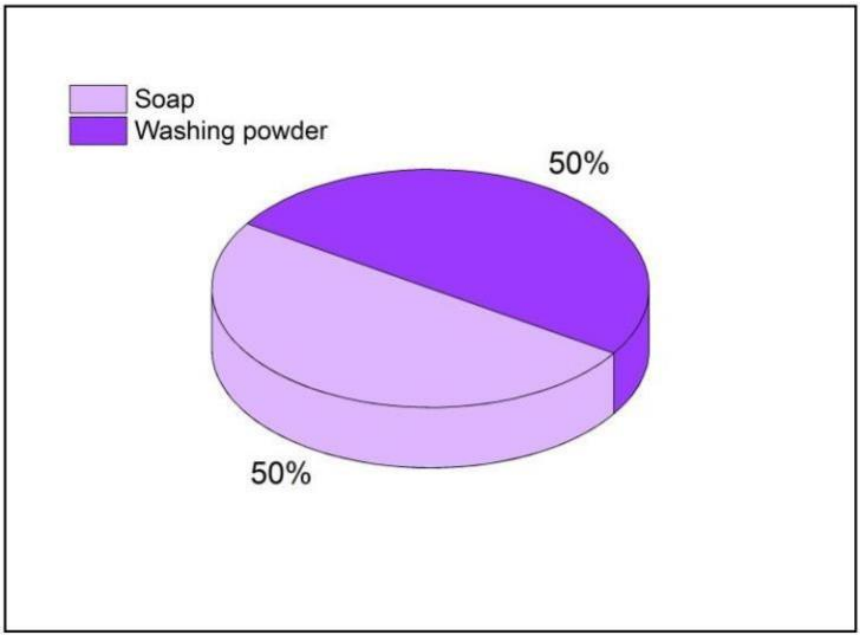


Graph 4(d): Analysis of various components obtained nail clippings collected from Gardeners

Pie chart depicting 16 contaminated samples out of 20 samples collected from people working in various Gardeners. Out of 32 contaminated samples 58.06% contained mud, 25.81% contained plant residue and 16.13% contained urea.



Graph 4(e): Analysis of various components obtained nail clippings collected from laundry cleaners

Pie chart depicting 2 contaminated samples out of 13 samples collected from people working in various cleaners. Out of 2 contaminated samples 50% contained soap and 50% contained washing powder.

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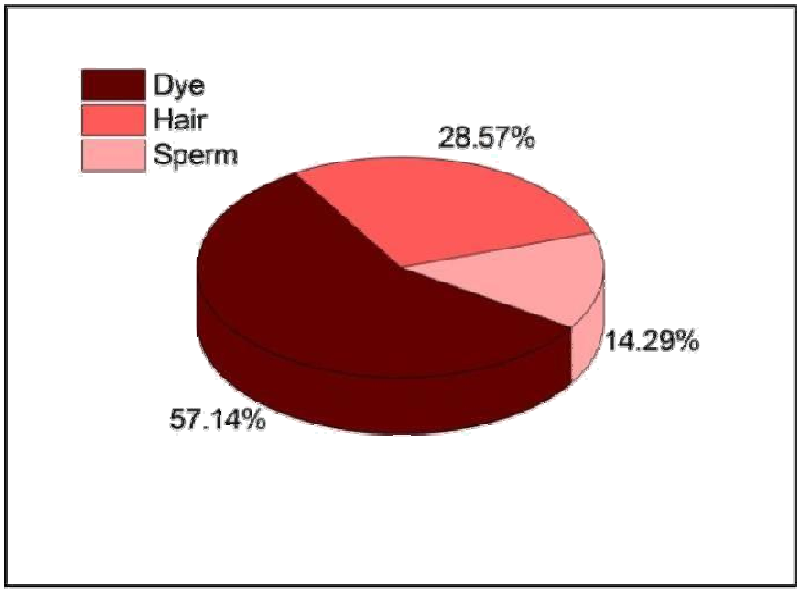
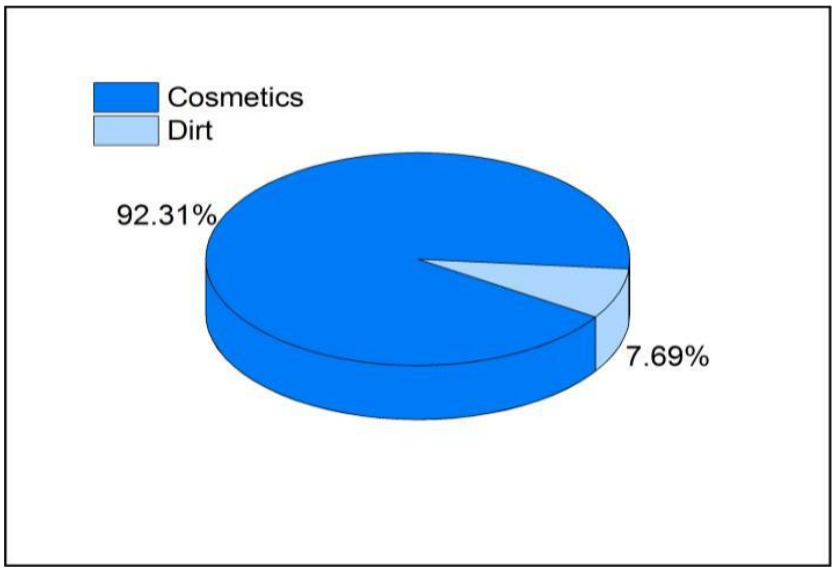


Graph 4(f): Analysis of various components obtained nail clippings collected from salon

Pie chart depicting 7 contaminated samples out of 16 samples collected from people working in various salon. Out of 7 contaminated samples 57.14 contained dye, 14.29% contained sperm and 28.57% contained hair.



Graph 4(g): Analysis of various components obtained nail clippings collected from Parlors.

Pie chart depicting 13 contaminated samples out of 24 samples collected from people working in various parlors. Out of 13 contaminated samples 92.3% contained cosmetics and 7.69% contained dirt.

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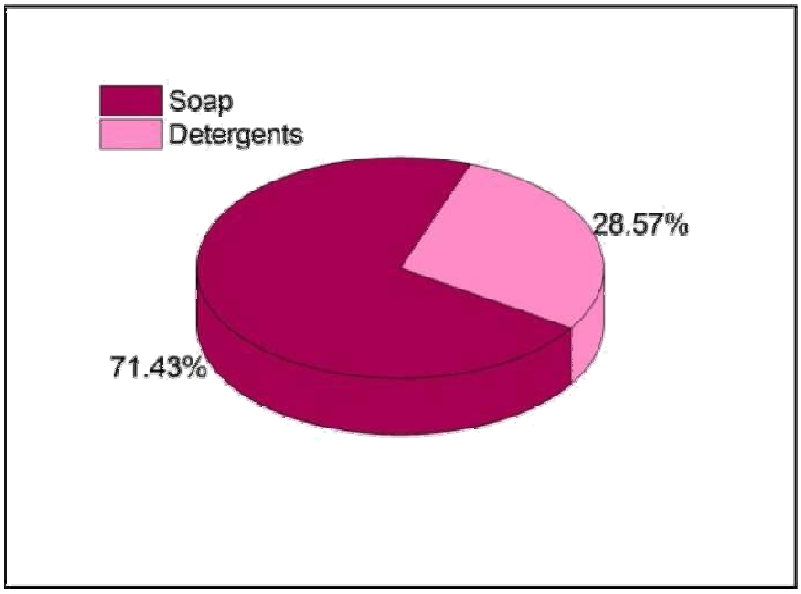
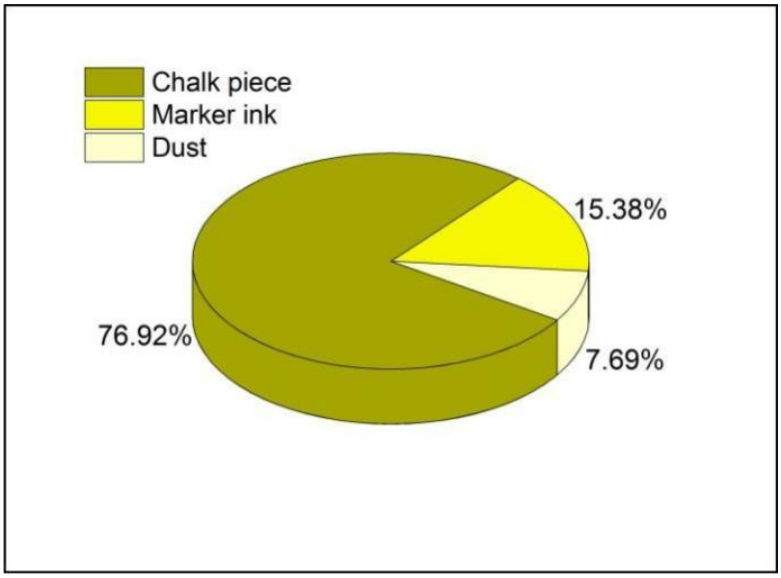


Graph 4(h): Analysis of various components obtained nail clippings collected from Health care workers

Pie chart depicting 7 contaminated samples out of 16 samples collected from people working in various Health cares. Out of 7 contaminated samples 71.43% soap and 28.57% contained detergents.



Graph 4(i): Analysis of various components obtained nail clippings collected from Teachers

Pie chart depicting 13 contaminated samples out of 22 samples collected from people working in various teachers. Out of 13 contaminated samples 76.92% chalk piece, 15.38 % contained marker ink and 7.69% contained dust.

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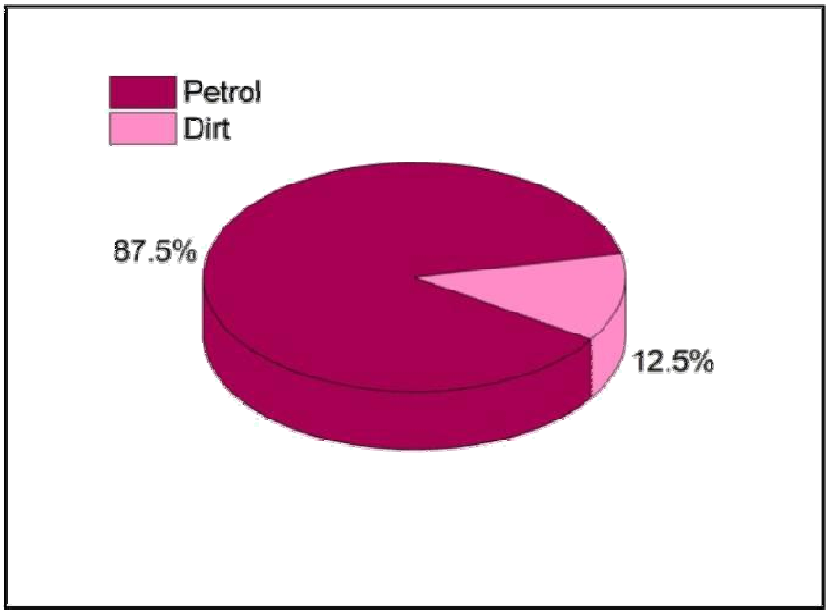
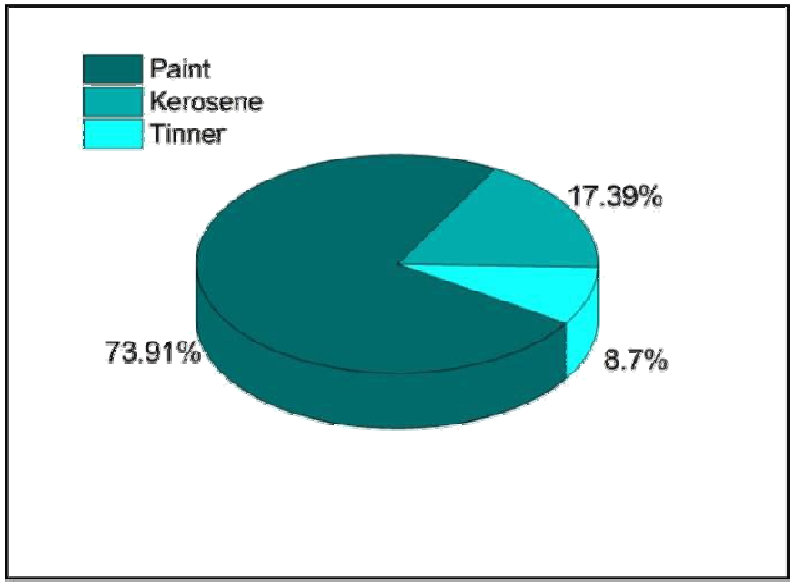


Graph 4(j): Analysis of various components obtained nail clippings collected from Petrol bunk workers

Pie chart depicting 16 contaminated samples out of 19 samples collected from people working in various petrol bunks. Out of 16 contaminated samples 87.5% petrol and 12.5% dirt.



Graph 4(k): Analysis of various components obtained nail clippings collected from Painters

Pie chart depicting 23 contaminated samples out of 26 samples collected from people working in various painters. Out of 13 contaminated samples 73.91% contain paint, 17.39% contained kerosene and 8.7% contained thinner.

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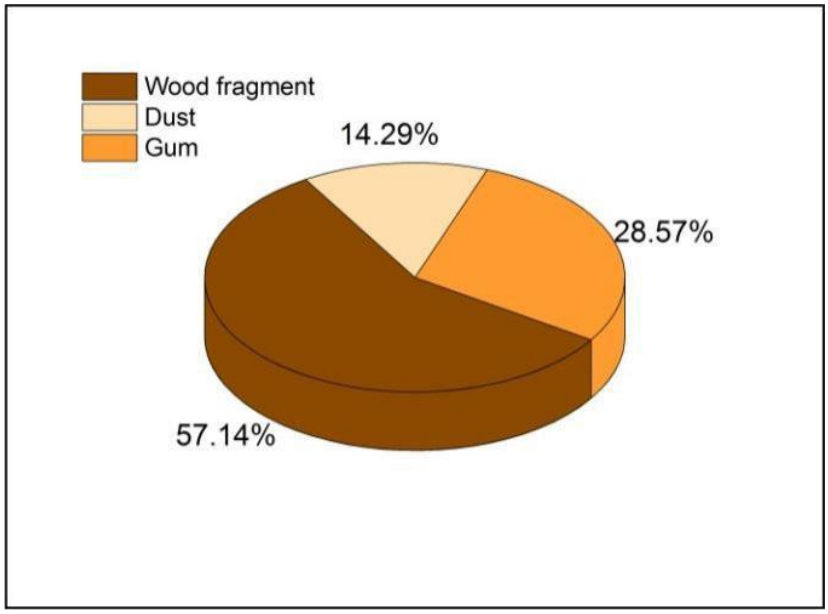
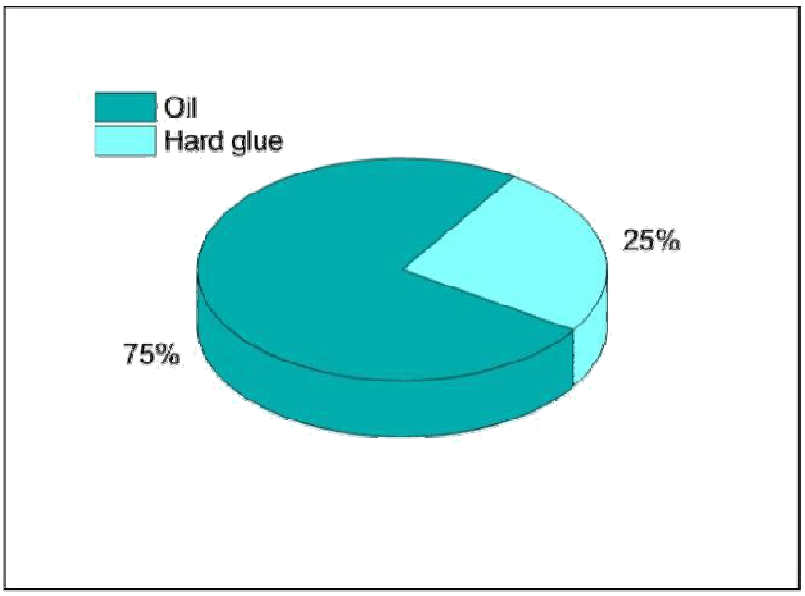


Graph 4(l): Analysis of various components obtained nail clippings collected from carpenters

Pie chart depicting 7 contaminated samples out of 11 samples collected from people working in various painters. Out of 7 contaminated samples 57.14% contain wood fragments, 28.57% contained gum and 14.29% contained dust.



Graph 4(m): Analysis of various components obtained nail clippings collected from oil store workers

Pie chart depicting 12 contaminated samples out of 15 samples collected from people working in various oil store workers. Out of 12 contaminated samples 75% oil and 25% hard glue.

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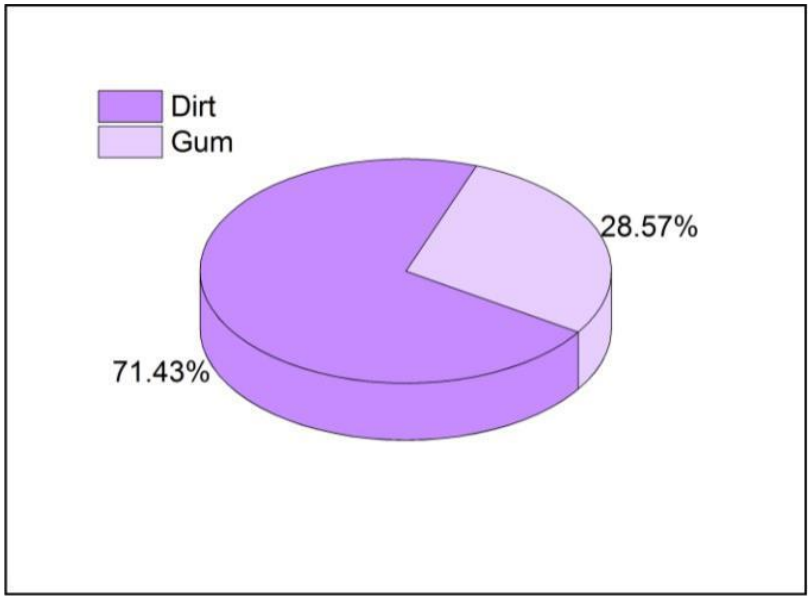
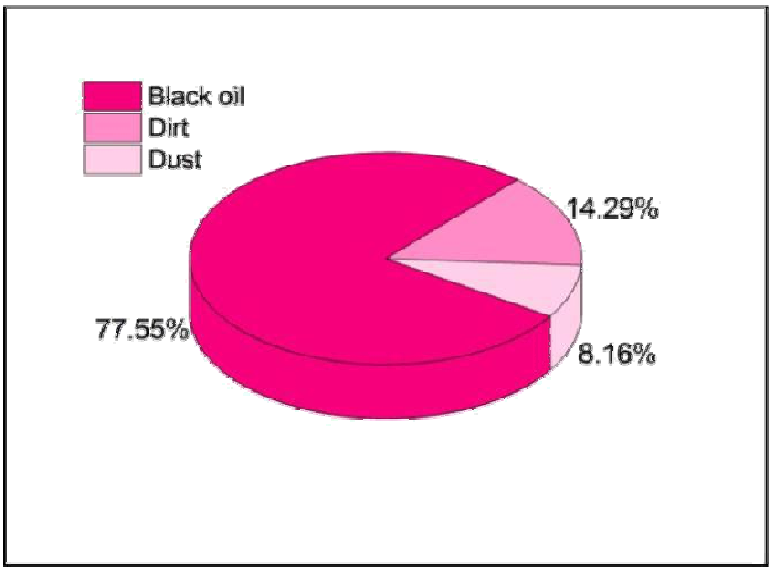


Graph 4(n): Analysis of various components obtained nail clippings collected from plumbers

Pie chart depicting 7 contaminated samples out of 10 samples collected from people working in various plumbers. Out of 7 contaminated samples 71.43% dirt and 28.57% gum.



Graph 4(o): Analysis of various components obtained nail clippings collected from Mechanics

Pie chart depicting 49 contaminated samples out of 54 samples collected from people working in various mechanics. Out of 49 contaminated samples 77.55% contained black oil, 14.29% contained dirt and 14.29% contained dust.

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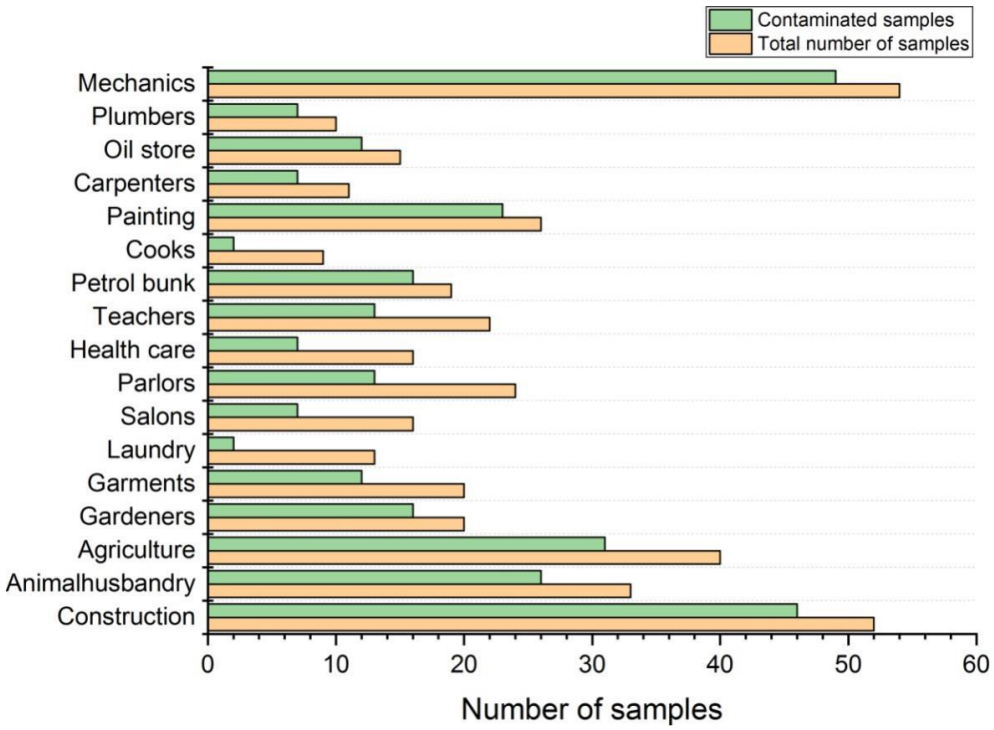

Graph 5: Bar graph representing Total number of samples collected in each category and the number of evidences found

72.25% of the nail clipping samples collected from survey conducted on 17 work places were found to be contaminated.

This correlating result gave us an idea that offender belonging to groups like painting, construction, animal husbandry, agriculture, garments, cooking, garden, parlor, salon etc. are easily identifiable according to the scraps found in their nail clippings giving an insight about their profession.

Conclusion

The contents and the samples dealt with above represents the occupation of the sample provider. A diversity is observed in the class of contaminants, but a few impurities like dung found in the sample of agriculturist and saw dust particles found in the sample of carpenter are rare and conclusive. If two samples of the same occupation are considered then other impurities assist identification. According to the number of different kinds of impurities or contaminants, suspect samples can be excluded as much as possible.

To assist the identification of bodies when establishing the identity is difficult, microscopic method of examination is used. According to the findings of the nail clippings this method can be either supportive or conclusive and can enhance the forensic investigations

Limitations: On the basis of the experimental observation, it is perceived that the research owns some limitations as well.

1. Usage of glove during commission of crime
2. Absence of physical evidence (presence of a software employee)

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3. Physically challenged people will have a totally different case
4. Usage of soaps or sanitizers may lead to the presence of very few or no trace evidence.

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