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Ashika Raveendran & Pushpa S. Murthy

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REVIEW



## New trends in specialty coffees - “the digested coffees”

Ashika Raveendran<sup>a,b</sup> and Pushpa S. Murthy<sup>a</sup>

<sup>a</sup>Department of Spices, and Flavour Science, CSIR-Central Food Technological Research Institute under, Mysore, India; <sup>b</sup>Academy of Scientific & Innovative Research (AcSIR), Ghaziabad, Uttar Pradesh, India

### ABSTRACT

Specialty coffee has gained immense popularity for its unique flavor and improved quality. There are large varieties of coffee trending every day due to the widened demand. Still, specialty coffee holds its place for its distinct processing inside the animal digestive system. Specialty coffees are also considered the most expensive due to coffee varieties with novelty in processing which leads to limited availability and less productivity. The digested coffee's uniqueness and rarity led to higher consumer demand, which paved the way for animal abuse in captivity and the production of fake authenticity to tackle the increased market requirement. In the context of coffee processing through conventional methods, the application of enzymes and microbes has brought about an improvement in coffee fermentation. Much research has been focused on the isolation of microbial cultures from the animal excreta and gastrointestinal tract. This review emphasizes the types of specialty coffee, its uniqueness compared to the traditional varieties, the bio-processing method of specialty coffee inside the animal gut and its taste profile.

### KEYWORDS

bio-processing; coffee; enzymes; fermentation; gastrointestinal tract

### Introduction

Coffee is globally cherished beverage with more than 500 billion cups consumption per year. Coffee prevails to be the second-largest commodity in market value exceeding a global production of 9 million tonnes next to petroleum (De CarvalhoNeto et al. 2018). It is an integral part of the human diet and is one of refreshing brew consumed in the world. Coffee has found to possess several health benefits (Je and Giovannucci 2014; Pimpley et al. 2020). Coffee based products also include refreshments (cola), pharmaceuticals and cosmetics other than brews.

The extensive manufacturer and trader of coffee is Brazil followed by Vietnam, Colombia, Indonesia, Ethiopia, Honduras, India and Uganda. For the period of 2020-2021 world's coffee production forecast 9.1 million bags (60 kg per bag) which are higher than the previous year record of 176.1 million bags in Brazil (United States Department of Agriculture (USDA) 2020). According to the reports, Brazil is the supreme leader in coffee production form a long period and exclusive breeder of diverse and variant coffees which spans the most customary coffee class. The subsequent chief producer for this period was Vietnam. Columbia remains to be the world's third coffee producer and their coffee varieties are familiar for its intense aroma. Indonesia favors for both the growth and market development of coffee because of its unique geographical location. Indonesia also plays an important role in coffee production with Robusta coffee being the major coffee produce in the country. Indonesian coffee production is expected to decline in

2021 (10.7 million bags in 2019-20 to 10.3 in 2020-21, United States Department of Agriculture, 2020). This reduction in coffee production is due to the delayed precipitation that negatively affected Robusta coffee yield. Different varieties of specialty coffees are also produced in small quantities in this country. Indonesian Arabica coffee is one of the world's strongest coffees, but it has limited production. Luwak Kopi is amongst the highly demanded and exorbitant Indonesian coffee variety that is produced and traded exclusively, depending on the civet cat. Indonesia is preceded by Honduras, Ethiopia, India, Uganda, Peru and Mexico in the coffee production rankings (Slavova and Georgieva 2019).

Different layers are developed on the coffee cherries upon ripening, which are exocarp, mesocarp and endocarp that keep the seed intact. Mucilage is the part of mesocarp of coffee cherries. All the coffee fermentation methods to-date aims to eliminate the mucilage layer that has abundant polysaccharides (pectin) and reduce the water content of coffee beans. The pectic mucilaginous coat in beans causes hindrance to its rapid drying that can favor microbial growths. Nevertheless, fermentation also has beneficial effects on coffee's quality attributes when carried out in controlled conditions (Haile and Kang 2019). Presently, there are three major kinds of post-harvest system that are employed for coffee processing: dry, wet and semi-dry process. The processing of coffee affects its flavor profile. Certain specialty coffees have a unique processing inside the gut of animal.

The demand for coffee has steadily increased over the past decades, and this necessitates consumers on the

production of different and novel varieties of coffee with the best quality. Specialty coffees are the highest graded coffees in terms of availability and its distinct flavor. There have been several varieties cultivated worldwide, based on their exceptionality and overall taste, a limited varieties have attained remarkable eminence. Of these, the most recognized are the Hawaii Kona coffee and Jamaican Blue Mountain particularly for its incomparable flavor. Hence these are regarded as the superior coffee varieties (Jumhawan et al. 2015). The Jamaican Blue Mountain and Tanzanian Pea berry are remarked for their premium price (Marcone 2004). The digested coffees have its special place among these selections for its exclusive processing, limited availability and smooth taste devoid of the bitterness compared to regular coffees.

## Types of animal fermented specialty coffees

### *Kopi luwak (civet coffee)*

Kopi and Luwak are the Indonesian phrases that denote coffee and civet, respectively. Asian palm civet (*Paradoxurus hermaphroditus*) is a nocturnal small cat-like mammal indigenous to both Northern and Southern Asian countries. The palm civet consumes the coffee berries to give rise to Kopi Luwak. In 1945, Kopi Luwak coffee originated from coffee farm plantations in Dutch and the local people received profit from the estate managers in return for these unusual beans (Marcone 2004). It is tough to obtain civet coffee. On an average, approximately 250-500 kg of civet coffee is obtained from wild civet cat every year. Kopi Luwak price up to \$35- \$80 per cup besides coffee beans range from \$100-600 per pound (Muzaifa et al. 2018). Civet coffee is regarded as one of the world's most luxurious and fewest coffee with an estimated annual production of 127 kg with price tag of up to \$200-400 per kg. These are widely available in international markets including Europe, USA and Asian countries such as Japan, Taiwan and South Korea (D'Cruze et al. 2014). The taxonomic classification of Asian palm civet as per Patou et al. (2008) is as below

### Classification

Kingdom: *Animalia*  
Phylum: *Chordata*  
Class: *Mammalia*  
Order: *Carnivora*  
Suborder: *Feliformia*  
Family: *Viverridae*  
Genus: *Paradoxurus*  
Species: *hermaphrodite*

### Process of luwak coffee production

Luwak instinctively chooses the coffee cherries by climbing the coffee trees. In the digestive process the coffee pericarp is thoroughly digested and the intact beans are excreted (Jumhawan et al. 2013). Ripe berries are subjected to Luwak's digestive tract for fermentation that takes

approximately 12 hours. The defecated beans are collected and cleaned, further dried at appropriate temperature for particular duration of time. Subsequently, the husk is removed then the coffee beans are dried and sorted. The green beans are roasted and ground to obtain the premium Luwak coffee. Conventional coffee dispensation requires long periods of processing that can be met with the fermentation inside the animal's gastrointestinal tract and are referred in Figure 1 (Mahendradatta, Israyantiand, and Tawali 2012).

There have been attempts to make the artificial Kopi Luwak due to its premium price and demand. Thus, a recent approach by Bektiarso et al. (2020) aimed to analyze the fermentation process in civet through the use of Extreme Low Frequency (ELF) magnetic field radiation and to optimize the *Lactobacillus* growth due to the fact that this species has role in fermentation of artificial civet coffee. In this study, pulped coffee berries were treated with  $\alpha$ - amylase enzyme for two hours of bio-processing and was further subjected to ELF magnetic field of 100 $\mu$ T and 300 $\mu$ T at three time periods (15 minutes, 30 minutes and 45 minutes) for each frequency along with the control. The *Lactobacillus* growth as well as the pH was monitored. It was concluded that there was improved growth of *Lactobacillus* at 300 $\mu$ T and there were no significant change in the pH during the process of artificial civet coffee production. Hadipernata and Nugraha (2018) have developed a fermentation technology using the bacterial isolates from civet gut. The pH and temperature was maintained similar to Luwak digestive tract. The peristaltic movement of intestine was replaced for the propellers in the bioreactor. Thus the artificial Kopi Luwak developed is claimed to be similar to that of the original Kopi Luwak.

### Physical quality

Civet feces constitute the excretion of the digestive civet phase. It is usually semi-solid with a mucus coat. The appearance of feces differs considerably (i.e., form, color, scale, texture) depending on the diet consumed by the civet (Muzaifa et al. 2018). The studies on the physicochemical property of Kopi Luwak states that these coffee beans were darker in color with higher reddish hue than the control beans. Surface examination of civet coffee beans through Scanning Electron Microscopy (SEM) analysis revealed that these civet coffee beans had smoother surface due to exfoliation of the outer surface of coffee beans during the fermentation process inside the civets gastrointestinal tract. There were also micro-pitting and structural difference in Kopi Luwak coffee after passing through the digestive tract of civet (Marcone 2004).

Recently, Adier, Reyes, and Arboleda (2020) studied a quick method by visible spectroscopy, ranging from 450 nm to 650 nm, to differentiate between the civet coffee and non-civet coffee samples. Civet coffee beans had lower absorbance values in visible spectra compared to non-civet coffee samples with process yields of 96.7 to 100% classification scores for quadratic discriminant analysis and logistic regression. Thus the application of visible spectroscopy along with

**Table 1.** Aroma and flavor description of civet coffee.

Luwak coffee	Reference
Fishy	(Muzaifa et al. 2018)
Nutty	
Herby	
Creamy	
Grassy-tobacco like	
Mint	(Patria, Abubakar, and Muzaifa et al. 2018).
Sweet	
Chocolaty	
Slightly earthy	

data mining would be useful in differentiating civet and non-civet coffee.

### **Chemical composition of luwak coffee**

There are few reports on the chemical properties of Luwak coffee. The bio-processing inside the gastrointestinal tract leads to lowering of caffeine content in both Robusta Luwak and Arabica Luwak coffees. There is also the development of distinctive odor due to the digestion. The roasting process decreases the volume of caffeine by a minimal proportion. In addition to caffeine, the protein content was also found to be low, indicating that the proteins were partially catabolized and seeped out within the animal's gastrointestinal tract during the digestion process. There is some evidence that the fermentation in Luwak's gastrointestinal tract improved its quality because of the ideal temperature. In addition to that, it is assisted by the bacteria in the gastrointestinal tract and coffee bean proteins are degraded by proteolytic enzyme in the gut. This gives rise to short peptides and free amino acids that provides a unique taste to Luwak coffee. After processing, in gastrointestinal tract, there is an increase in coffee's lipid content compared to original coffee which relates to higher lipid content provides delicious taste (Mahendradatta, Israyantiand, and Tawali 2012).

According to Jumhawan et al. (2015), in the metabolite analysis, the discriminant markers were found to be citric acid and malic acid. Both these compounds were considered to be the fingerprint for Kopi Luwak. This is useful for the authentication of Luwak coffee and quality evaluation of civet coffee. Burns and Walker (2020) tried to authenticate Kopi Luwak through various methods such as spectroscopic analysis and its DNA identification. Various well curated information of databases has also been developed for providing information on the authentication of civet coffee over multiple techniques.

### **Sensory attributes of luwak coffee**

Sensory analysis is an essential method for the characterizing the various coffee types. In the coffee sector, sensory assessment is known as cupping. Volatile compounds accounts for the aroma characteristics, while nonvolatile compounds describes the acidity of the coffee (Fisk et al. 2012).

### **Aroma**

The quality of coffee is expressed in terms of fragrance, which refers to the aromatic evaluation of dry coffee

grounds, while the aroma is also described from the coffee liquor. The coffee aroma formation is an intricate process. The aroma involves the composite mixture of volatile compounds such as pyridines, pyrazines, pyrazoles, aldehydes, furans, oxazole, ketones and phenols developed during the process of roasting (Buffo and Cardelli-Freire 2004; Toci and Farah 2008). Wild civet coffee incorporates a rich aroma, flavor and aftertaste, good balance. It sometimes accompanies an earthy aroma also. The aroma of civet coffee is influenced by the kind of food consumed by the civet. The wild civet ingests several types of food in the forest, while the fruits such as guava and papaya are most frequently provided for feeding caged civet, and fascinatingly the aroma of the fruit appears on the processed coffee (Muzaifa et al. 2018).

Sensory panel evaluation is one of the methods for determining the aroma profile but it has the limitation of individual training and variability. Thus the Electronic nose (E-nose) is an emerging strategy to overcome this disadvantage and to distinguish the odors (Shilbayeh and Iskandarani 2004). Ongo et al. (2012) reported the Chemometric pattern method to discriminate the civet coffee and the control bean (that has not been digested by the civet). The study was an enhanced method to differentiate civet coffee. One of the prominent quality attribute of civet coffee is its characteristic aroma which was analyzed using E- nose. The Chemometric discrimination of civet coffee with E-nose and GC-MS has revealed clear separation between Kopi Luwak and the control beans. This also states that the variety of the coffee and the regional location also influences the coffee aroma and its variable volatiles.

The detection and classification of coffee aroma by E-nose method has been the interest of several researchers like Wakhid et al. (2020) who aimed to improve the civet and non-civet coffee classification. According to this study the aroma of coffee is determined using E- nose sensors with different sensitivity of certain chemicals. The coffee aroma classification includes the following steps such as ground truth data acquisition, statistical feature extraction, classification and performance evaluation. The research focused on distinguishing the civet coffee and non-civet coffees that compared the six classes of coffees has shown a clear difference in aroma with the use of E-nose. It gave a distinguishing accuracy of 100% between two classes of civet and non-civet coffees. Furthermore classes of Kopi Luwak and non-Kopi Luwak coffee mixes from different geographical regions could be explored by E- nose analysis. Recently, Harsono, Sarno, and Sabilla (2020) have reported to recognize Arabica and Robusta coffee varieties through the use of E-nose. The use of various parameters and statistical comparison approaches like Logistic regression (LR), Linear Discriminant Analysis (LDA) and K- Nearest Neighbors (KNN), they suggest the best results (approximately 97.7%) could be obtained by KNN method.

### **Flavor**

In a roasted and ground coffee, the flavor compounds rely on several factors, two of which are of significant relevance.

First, the variety and quality of green coffee; creates the basis for the further production of flavor during roasting. Secondly, the roasting process unlocks the green coffee bean's flavor potential and produces the coffee taste that is highly appreciated by coffee connoisseur worldwide (Lindinger et al. 2008). Although the reports on the sensory quality of civet coffee are limited, there has been information on the comparative studies on wild and caged civet (Muzaifa et al. 2018). The flavor and aroma profile of Luwak coffee has been described in Table 1.

As mentioned earlier in this article, there are changes in the chemical composition of coffee bean during the process of digestion inside the Luwak's alimentary tract and it also influences the taste profile. The major change that develops is the breakdown of protein which gives rise to free amino acids that affects the taste of Kopi Luwak (Muzaifa et al. 2019b). There are reports on the sensory profile of Kopi Luwak that correlates with the amino acid composition. Amino acid are said to play a major role in the sensory aspect of Luwak coffee. A study on the amino acid composition revealed that Kopi Luwak has higher percentage of Valine, L- Glutamine, Aspartic acid and Glutamic acid. Valine contributes to the body and balance while Glutamic acid contributes to the acidity, flavor and fragrance of Luwak coffee. Histamine also influences the acidity, after-taste, flavor and overall sensory attributes of civet coffee (Muzaifa et al. 2019b). The lower level of proteins due to proteolysis leading to shorter peptides and amino acids would contribute to the decreased bitterness of Kopi Luwak (Marccone 2004).

### **Ivory coffee (elephant dung coffee)**

Ivory coffee or Elephant dung coffees are produced exclusively by Ivory Coffee Company in Thailand that is branded as the Black Ivory Coffee. The trademark taste of this coffee has been portrayed as "smooth without the harshness of standard coffee" with a cost of \$1800 per kg. Ivory coffee is one of the highly-priced coffees in the world. Each year the productivity is limited to approximately 200 kg (Thammarat et al. 2018). The company suggests a requirement of approximately 33 kg of coffee for the production of 1 kg of Black Ivory Coffee. The best cherries of Thai Arabica are selected for the production of this exotic variety. The coffee beans are fed to the elephants along with other foods, such as rice, banana and tamarind in order to obtain this variety of coffee. The classification of Asian Elephant as per Choudhury et al. (2008) is described below

### **Classification**

Kingdom: *Animalia*  
Phylum: *Chordata*  
Class: *Mammalia*  
Order: *Proboscidea*  
Family: *Elephantidae*  
Genus: *Elephas*  
Species: *maximus*

### **Process of ivory coffee production**

Ivory coffee is usually procured from Arabica coffees, which are obtained from the feces of Asian elephant (*Elephas maximus*). The digestion and fermentation of coffee cherries occurs inside the elephant's alimentary canal for 12 to 70 hours, along with several other food ingredients. To obtain the perfect green beans the coffee is further washed, dried, hulled and sorted (Thammarat et al. 2018).

### **Chemical composition of ivory coffee**

The comparative studies on Ivory coffee and the conventional coffee have reported a similar profile i.e., both containing same 78 tentative volatile compounds. These compounds were further classified into 13 chemical classes. There were no unique compounds identified from elephant dung coffee. Therefore comparative compound peak areas of were investigated. Following this, four compounds were identified as discriminant markers: 3-methyl-1-butanol, 2-methyl-1-butanol, 3-penten-2-one, 2-furfurylfuran. These are useful for the authentication and quality control of Ivory coffee (Thammarat et al. 2018).

Haile, Bae, and Kang (2020) have reported that elephant dung coffee has higher Total Phenol Content (TPC) than coffee beans obtained from conventional processing. The increase in total phenol content of Ivory coffee compared to the regular coffee may be correlated with its distinct processing in gastrointestinal tract. Coffee beans are subjected to various alcohol, acids and digestive enzymes inside the elephant's digestive tract that may have caused the breakdown of complex molecule present in the coffee beans and increased the phenolic content during the extraction time. The total phenol content was higher in slightly roasted Ivory coffee beans than those roasted at various temperatures. The total flavonoid content was improved in both green and roasted elephant dung coffee compared than conventional processed coffee beans. The elephant dung coffee had significantly higher total tannin content compared to regular coffee beans.

### **Sensory attributes of ivory coffee**

There have been comparative studies on the conventionally processed coffee and Ivory coffee. It reveals that few unique compounds present in Ivory coffee whose characteristic odor types have been described. These compounds were 2- hydroxymethylpyrrole, 3-methylfuran, 2- methylfuran, 2- ethyl-3-methylpyrazine, 2- hexanol. The compounds 2-methylfuran, 2-ethyl-3-methylpyrazine and 2-hexanol have an odor type of chocolaty, nutty and earthy respectively. Further other compounds found in Ivory coffee are propionic acid which is pungent, rancid and unpleasant odor type. The compounds such as 4-ethylguaiaicol (spicy), 1-furfurylpyrrole (vegetable), 2-methylphenol (sweet, phenolic) were also reported (Haile, Bae, and Kang 2020).



### Antioxidants

Coffee is regarded as a rich source of antioxidants for almost two-third of the population (Sridevi, Giridhar, and Ravishankar 2011). A comparative study on different processing methods was conducted, which suggested that the bio-processing method inside the elephant gut gives a better outcome on the antioxidant activity of coffee. In comparison with the wet processed coffee beans and dry processed coffee beans, the 2, 2-diphenyl-1-picrylhydrazyl (DDPPH) free radical scavenging activity of elephant dung coffee was higher. Usually, the green coffee beans had higher DPPH activity than the roasted coffee beans (Haile, Bae, and Kang 2020).

### Jacu coffee

Jacu coffee is one of the most remarkable and claims to fame Brazilian coffees obtained from Jacu bird (Guan). These coffees are newly emerging specialty coffees within the block. Jacu bird is indigenous to the Atlantic rainforest. It is a frugivorous (fruit feeding) bird, yet additionally benefits from sprouts, leaves, insects and grains. It consumes coffee cherries as they are sweet with high sugar content. Despite the fact that they inhabit in the woods, it also moves to the open field for foods. The seeds of the coffee cherries are ingested and defecated intact. It is the most expensive coffees of Espirito Santo State that is estimated to a cost of \$112.29 per kg (Malacarne et al. 2017).

### Classification

Kingdom: *Animalia*  
Phylum: *Chordata*  
Class: *Aves*  
Order: *Galliformes*  
Family: *Cracidae*  
Genus: *Penelope*  
Species: *obscura*

### Monkey parchment coffee

The Monkey Parchment Coffee or monkey spit coffees are the less explored specialty coffee. This variety of digested coffees has its origin both in India and Taiwan. The monkey eats the ripe cherries from coffee farms, consumes the pulp and spits out the coffee seeds. In some cases a few coffee cherries are swallowed and the seeds are excreted. The coffee producer's faces threat during the harvest season of coffee, as these monkeys visit the coffee estates to get the ripe berries. A study on the feeding behavior of monkey during the production monkey parchment coffee was reported. The monkeys were fed with coffee berries along with their regular food. This includes banana, cabbage, leafy vegetables, sweet lime, nuts, water melon and grapes. It was noted that the monkey took the berry in hand removed the pulp and suck the pulp juice in reserved the beans in mouth for some time, chewed spit the coffee beans slowly and then spit the beans. The flavor profile of these coffees was better from the regular coffees (Sadananda, Prakasan, and Hameed 2010).

### Gut microbes in specialty coffee

Few investigations focus on the array of microbes present in the gut flora of animals fermenting specialty coffees, making them prominent. Lactic acid bacteria existing in the alimentary canal may contribute in the fermentation of coffee as they have enzyme activity (mainly protease and pectinase). The microbes have the ability to hydrolyze proteins and pectins. This indicates that the isolates could serve as a potential starter cultures for the fermentation of coffee. The degradation of proteins results in free amino acids, while hydrolysis of pectin yields simple sugars. The results of the degradation of these two components can affect the taste of coffee during roasting (Muzaifa et al. 2019a).

An insight into the civet's gastrointestinal tract indicates *Enterobacteriaceae* as the most prominent reviewable inoculum of bacteria in Luwak's alimentary canal. Apart from this, the genera such as *Escherichia*, *Bacillus*, *Pseudomonas*, *Lactobacillus*, *Pantoea*, *Ochrobactrum* and *Kocuria* are also observed in cultures (Suhandono et al. 2016). The microbes having the ability of caffeine-degradation were also isolated from the feces of Luwak includes *Methylobacterium populi*, *Klebsiella quasi pneumoniae*, *Raoultella ornithinolytica*, *Stenotrophomonas schelatiphaga* (Iswanto et al. 2019).

A recent research by Watanabe et al. (2020) microbiome characterization of Luwak feces revealed unique aerobic *Gluconobacter* species which grows at 37 °C optimum body temperature dominates the gut microbiome of civet. The most abundant were found to be *G. japonicas*, *G. frateuii*, *G. wancherniae* and *G. nephelli* using 16S rRNA sequencing. It has been reported that *Gluconobacter* species have more genes of cell mobility and amino acids consisting of hydrogen sulfide and sulfur. These may influence the process of fermentation of Kopi Luwak inside the gastrointestinal tract.

### Demerits of specialty coffee

The specialty coffee has been noted to have a particular attribute of nutty and fishy aroma which is a drawback of digested coffees. Luwak farming is a solution for its limited production, but this method has been blocked due to animal ethical rights. The prominence and escalating need for Luwak coffee have contributed contrarily to adulterants promising its origin. Unfortunately, there are still no convenient quality control measures to test this aspect. The biological process inside the Asian civet or Luwak intestine during fermentation still seems unclear. Apart from that, there are limited scientific reports on the quality of Luwak coffee. Since these coffees are developed only at unique locations, the studies concerning these coffee productions are limited for both wild and farming methods.

### Conclusion

In conclusion, this review focuses on specialty coffee, its types, processing methods of specialty coffee, chemical, sensory analysis and the demerits of specialty coffee. Coffee has been a popular beverage for ages. Its popularity is

embarking positive inclinations every day with newer varieties. Coffee has a long-standing history and researches have investigated its varying aspects for long. The recent focus has been on the specialty coffees due to its unique processing. The post-harvest practice of coffee has contributed to its peculiar flavor. The conventional coffee processing methods primarily includes dry, wet and semi-dry processing. Furthermore, there have been numerous attempts to use enzymes in coffee processing to aid in the fermentation of coffee. In specialty coffee, especially in digested coffee, the coffee cherries pass through the gastrointestinal tract. This fermentation method has acknowledged this variety to a great extent and placed it as one of the premium and exotic coffees worldwide, raising the coffee market.

### Future prospects

Specialty coffee processing can bring about an improvement to the existing coffee marketing. The high cost of animal processed coffee has been due to its processing methods that have not been completely understood. The chemical metabolics and sensory analysis of these digested coffees is still limited. Since the animal digested coffee passed through the animal's gut and excreted, the coffee beans need to undergo processes further to eliminate the contaminants and the fishy aroma. The limited production of these varieties had urged the coffee producers for animal farming, which leads to ethical concerns. There are many forgeries to this coffee variety for its limited availability, as there is less scientific studies on determining its quality. There are also many other kinds of digested coffees emerging, which need to be explored.

Specialty coffee processing still is an unexplored field that provides immense scope for the researchers. Luwak coffee has limited scientific evidence and some aspects specifically the modulation of the chemical pathway, chemistry and organoleptic profiling still are not exploited. The processing of specialty coffee is still unclear. Added types of specialty coffees such as Jacu coffee, the emerging monkey parchment coffee and few accompanying digested coffees need more scientific evidence. These specialty coffees could be further investigated with newer technologies, which provide a promising future to exotic varieties.

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