Quality Analysis of Coffee Bean Treated by Sunning and Water Washing processing

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Abstract. The quality of coffee bean determines the evaluation of coffee cup. The Coffea arabica was selected for initial processing and cup quality analysis by sun and water washing treatment, respectively. The results showed that the caffeic acid was bright in cyclic washing treatment, the balance was the best in washing processing, the mellow in semi-washing was better, but the comprehensive quality of sunning was the best. This study provides a theoretical basis and practical reference for the production and processing of Yunnan coffee.

1. Introduction

*Coffea arabica* is Rubiaceae coffee genus. The quality of *C. arabica* is affected by many factors, but the altitude and latitude of planting, and the initial processing technology have much influence on its quality. It is also generally believed that coffee flavor at the high altitude is better than at the low altitude. Yunnan has the natural advantage and has created a three-dimensional climate suitable for the growth of *C. arabica* which has a strong flavor of roasted peanuts and roasted nuts, with a little fruity aroma, and is famous for its fragrance but not strong, not bitter, slightly sour taste [1].

Sunning is the earliest and most simple processing method of traditional coffee beans. Because it does not involve the fermentation process, pectin is preserved and dried, and the sweetness is relatively high. In the Middle East, Latin America, Northeast Africa and other regions, as well as most of our coffee production and processing areas in China, always use Sunning. Sunning coffee beans are usually sweeter and more mellow than wet-processed coffee beans, with a better taste, balanced taste, and a peaceful bitter and soft sour taste. However, the drying time is long, the quality is easy to be affected by the weather, and the quality control problem is difficult to guarantee. In the process of natural drying, fresh fruit is easy to mix with miscellaneous substances on the drying rack. Compared with washing treatment, the proportion of inferior beans will also increase.

Water washing treatment is the most popular way of coffee processing. In the whole fermentation process, it mainly depends on the action of enzymes and microorganisms in the air to degrade and hydrolyze pectin [2-4]. In Hawaii, Mexico, Kenya, Colombia, Guatemala and Costa Rica, coffee is processed by water washing. It is generally believed that the quality of coffee beans processed by water washing treatment is generally higher than that processed by sunning or other treatment methods [3-5]. After the fresh coffee cherry is treated by water processing, the sugar content in the raw bean will decrease, because the raw bean is soaked and fermented in water, which causes some sugar to be dissolved in water and other chemical reactions will occur. However, when the sweetness decreased in germination, the concentration of some amino acids in coffee will increase, which contribute to the most of the aroma components in coffee. So water washing coffee beans had a unique aroma far more than other kinds of coffee beans. In addition, washed coffee beans have high purity, good appearance and
color, high taste consistency, and have a brighter sense of acid, overall quality is higher. However, the process of water washing treatment is complex, the water demand is large, the cost of equipment and production is relatively high, and the price is higher than that of sunning. At the same time, in the drying step, if the natural drying method, the requirements for sunshine are relatively high.

The semi-washed processing method originated in Indonesia and is widely used in the production and processing of coffee in Sumatra, Costa Rica and Indonesia. It combines the characteristics of sunning and water washing treatment, saves more water resources than water washing treatment, preserves the pulp of fresh coffee fruit, and produces coffee with mild taste, mild acidity and aroma of Chinese herbal medicine. The coffee beans produced in this way taste more mellow than the water washing treatment, the flavor is more pure than the sunning, and its flavor and taste are also between the two. Semi-washed coffee has the sweetness and consistency of sun beans [6]. It is also clean and soft with washed beans, which makes the taste of coffee better.

As one of the feature industries in Yunnan, the development speed of coffee industry is slow, and the processing technology is lagging behind. Due to the lack of scientific, theoretical guidance and standardized production system, Katium failed to give full play to its best flavor quality, which seriously restricted the upgrading and improvement of Yunnan coffee product quality. At present, it is very urgent to find out the processing suitable for Katium coffee beans in Yunnan Province.

2. Materials and Methods

2.1 Research materials
Coffee fresh fruit was from Nanling Ma Li Village coffee in Lancang County, Yunnan Province (60 kg in this experiment). Average rainfall is 1200-1300 mm, annual average temperature is 5℃-23℃, the shading is 35%-45%, plant spacing is 1.5*2 m.

2.2 Instrument equipment
Color separator, dry peeling machine, GEMILAI -GRM9008 bean mill, MK-MFFT1 fermentation tank, MK-HPD1 dryer (dryer), pH meter, sugar meter, TDS detector, cup measuring appliance, high precision analysis electronic balance, international red water precision temperature and humidity meter.

2.3 Research methodology

2.3.1 Sunning (A1)
Three different batches of coffee fresh fruit (15 kg per batch of 5 kg) were poured into a special cleaning pool and then poured into the fresh fruit color separator to select semi-ripened fruit and black fruit, leaving red fruit suitable for making fine coffee. The red fresh fruit after color selection was laid in the drying field for natural drying [7]. To reduce the moisture content of coffee beans to about 10.5%-11.5% and turn them into dried fruits, then remove stiff fruit shells with machinery (e.g. sheller) to prepare raw coffee. Finally, remove the seed coat (silver skin) of coffee beans, pack them with plastic bags and mark sample information, waiting for testing.

2.3.2 Water washing treatment (A2)
Three different batches of coffee fresh fruit (15 kg per batch of 5 kg) are poured into a special cleaning pool, then poured into a fresh fruit color separator to select semi-ripened fruit and black fruit, leaving red fruit suitable for making fine coffee. After removing the peel and pulp of coffee, mechanical peeling (such as peeling machine), pour the attached pectin coffee beans into a special clean fermentation tank and use water as a medium [8]. To ferment (at this time coffee seeds still retain the original pectin), according to the fermentation tank and coffee beans specific conditions (such as water temperature, water cleanliness and other factors) to determine the length of fermentation time. In general, when the pectin is no longer tightly glued to the coffee shell, or when the pectin is all off and accompanied by a strong fermentation taste, the pectin is washed out with running water. Finally, the water content of raw
beans with shell was reduced to 10.5%-11.5% by machine drying or sun drying. Finally, the seed skin (silver skin) of coffee beans was removed, and the sample information was divided and marked with plastic bag, waiting for detection.

2.3.3 Semi-washing treatment (A3)
Three different batches of coffee fresh fruit (15 kg per batch of 5 kg) were poured into a special cleaning pool, then poured into the fresh fruit color separator to select semi-ripened fruit and black fruit, leaving red fruit suitable for making fine coffee. The peel and pulp of coffee were removed by peeling machine, then the anhydrous fermentation was carried out, and the coffee beans were poured into the clean fermentation tank for anhydrous fermentation [9]. After cleaning with a large amount of water, some pectin is retained on the coffee seed coat (bean shell) because of the short fermentation time, which helps to increase the flavor of coffee. At this time, coffee beans are spread out in the drying field or dried with a dryer to further reduce the moisture content, the water content must be reduced to 10.5%-11.5% (drying time depends on outdoor temperature, heating degree or weather conditions, generally 14-28 days can reduce the moisture content of raw beans in coffee fresh fruit to 10.5%-11.5%). Then the coffee beans remove silver skin (seed skin), dry mucus and silver skin are removed at one time, and finally classified and bagged, waiting for detection.

2.3.4 Cycle water washing treatment (A4)
Three different batches of coffee fresh fruit (15 kg per batch of 5 kg) were poured into a special cleaning pool, then poured into the fresh fruit color separator to select semi-ripened fruit and black fruit, leaving red fruit suitable for making fine coffee. Remove the peel and pulp of coffee with peeling machine. Pour pectin coffee beans into a special clean fermentation tank for 24 hours. Then, in the fermentation tank, clean water fermentation for 24 hours, then rinse with water, so repeat 3 cycles, until the fermentation time reaches 72 hours [10]. Pectin has all fallen off and has a strong special fermentation flavor, at this time the fermentation is completed the pectin is washed out with running water. Finally, the water content of raw beans with shell was reduced to 10.5%-11.5% by machine drying or sun drying. Finally, the seed skin (silver skin) of coffee beans was removed, and the sample information was divided and marked with plastic bag, waiting for detection.

3. Cup Quality Analysis

3.1 Sample baking and cup testing
Sample baking according to SCAA baking index #55. The 150 ml of water is brewed over 8.25 g of coffee. The evaluation indexes and grades of coffee cups in this experiment include: Fragrance/Aroma, Flavor, Sweetness, Acidity, Aftertaste, Body, Balance, Uniformity, Clean up, Defects: including Taint, Fault, Set each indicator to five ratings, And each item is scored according to the coffee sensory evaluation criteria, The full score is 10. Fuzzy Mathematics Comprehensive Evaluation Method [11]. Sensory evaluation method for experimental samples of beans [6]. (Note: Sample baking is ensured within 24 hours, and the experimental sample cup test is performed after 8 hours.)

4. Results and analysis

4.1 Physiochemical Properties of Raw Bean
Water content of raw bean (WRB) was significantly higher in sunning (A1) than in washing treatment (A2), semi-washing treatment (A3) and cycle water washing treatment (A4) treatments. there was no significance of WRB between A2 and A3 (fig. 1).

A1 has the best quality and the least defective beans. A2 and A3 have 0.96% defective beans, which are lower than in A4 treatment (1.16%) (tab. 1).
Different lowercase letters in the figure indicate significant differences among treatments (P < 0.05). The data in the figure give the mean ± standard error.

Table 1 Properties of Raw Bean

| Sample group | A1 | A2 | A3 | A4 |
|--------------|----|----|----|----|
| Testing Content | Coffee peel tea | Tropical fruit flavors | Smell normal | Smell normal |
| Smell |  |  |  |  |
| Water (%) | 11.5 | 10.7 | 10.7 | 10.3 |
| Light yellow | 840 | 817 | 818 | 810 |
| Density (g/L) of particle size(#) | ≥16#98.5 per cent | ≥16#99.7 per cent | ≥16#98.4 per cent | ≥16#99.6 per cent |
| Water activity (aw) | 0.532 | 0.490 | 0.494 | 0.510 |
| Deeds | 0 | 0 | 0 | 0 |
| Primary defects | 0 points (0%) | 0 points (0%) | 0 points (0%) | 0 points (0%) |
| Secondary defects | 3 points (0.73%) | 4 points (0.89%) | 4 points (0.96%) | 5 points (1.16%) |
| Total defects | 3 points (0.73%) | 4 points (0.89%) | 4 points (0.96%) | 5 points (1.16%) |

4.2 Sample cup test results

After baking, the raw bean samples were evaluated by cup test: A1, A2, A3, A4 cup test scores are above 80 points, to achieve the grade of boutique coffee beans. And A1 has the highest cup score and the best quality, followed by A2, then A3 and finally A4.

Table 2 Cup Score

| Items | Dry/wet | Flavor | Afterward | Acid | Full-bodied | Balance | Integrated considerations | Cup scores | Flavor Description | Cup Score Rank |
|-------|---------|--------|-----------|------|-------------|---------|---------------------------|------------|-------------------|----------------|
| A1    | 7.92    | 7.58   | 7.50      | 7.58 | 7.33        | 7.42    | 7.58                      | 82.91      | Tropical fruit, honey, acid bright | 1             |
| A2    | 7.62    | 7.50   | 7.42      | 7.50 | 7.33        | 7.50    | 7.50                      | 82.42      | Caramel, berry, red wine | 2             |
| A3    | 7.50    | 7.42   | 7.25      | 7.42 | 7.42        | 7.25    | 7.50                      | 81.68      | Nuts, caramel, chocolate | 3             |
| A4    | 7.42    | 7.25   | 7.17      | 7.42 | 7.17        | 7.25    | 7.17                      | 80.85      | Nuts, caramel, acid bright | 4             |
5. Conclusion
When the water content of coffee is insufficient, the aroma, flavor, aftertaste and mellow degree of coffee will decrease. Therefore, water content is an important factor affecting the quality of coffee. For *Lancang C. arabica*, 10.5%-11.5% is a more suitable drying degree (water content) range.

Fermentation degree in the initial processing can improve the quality of coffee beans. Fermentation degree in washing treatment has an important effect on the aroma, flavor and acid quality of coffee. The lightly fermented coffee is inclined to have green tea, red wine, tropical berry flavor. However, the fermented coffee is inclined to have nuts, caramel and chocolate flavor in light fermented coffee. Therefore, the comprehensive quality of sun treatment is the best. Therefore, among the four coffee beans, the cup score is ranked as: A1 is the best, followed by A2, then A3 and finally A4, cup score is above 80 points, reaching the grade of boutique coffee beans. Under the condition of the same variety, water content and baking degree, the caffeic acid in cyclic was hing treatment is bright, the balance of washing treatment is the best, the mellow degree of semi-washing treatment is the best, and the comprehensive quality of sun treatment is the best.

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