REKAYASA 18 (2) (2020): 57-63

REKAYASA

Jurnal Penerapan Teknologi dan Pembelajaran

http://journal.unnes.ac.id/nju/index.php/rekayasa

Water Content and Proximates in The "Gedong Kendal" Coffee Variety after Processed by Roasting Machine

Kriswanto[1]*, Bayu Wiratama[2], Ria Wulansarie[3]

[1] Mechanical Engineering Education Department, Universitas Negeri Semarang, Indonesia,
[2]Management Department, Universitas Negeri Semarang, Indonesia
[3]Chemical Engineering Department, Universitas Negeri Semarang, Indonesia

Email: kriswanto@mail.unnes.ac.id[1]

DOI: http://dx.doi.org/10.15294/rekayasa.v18i2.27545
Submit : 6 Maret 2020; Revisi: 4 December 2020; Accepted: 30 December 2020

Abstract

One of the coffee producers in Indonesia, namely Gedong Koffee Patean, still uses conventional roasting with uncontrolled temperature, resulting in uneven color and content. The variants of coffee beans available are Kopi Rakyat, Kopi Lanang, Robusta Fermentasi, Robusta Fermentasi 1, Excelsa Natural Dry, Robusta Natural Dry with different characteristics. The Godeng Kendal coffee association was given a roasting machine for roasting coffee bean products and analyzed for water, carbohydrate, protein and fat content The quality of coffee is affected by the roasting process with a 5 kg roasting machine which can be set to 200 for 25 minutes. The quality of coffee after roasting then has an average moisture content of 10.5%. Furthermore, the chemical properties of each variant were tested to obtain carbohydrate, protein, and fat content at the Laboratory of Biology. Analysis of carbohydrates using the Luff Schoorl method, protein using the kidney test, and fat using a soxhlet extractor. The test results show that the highest carbohydrate content is found in Robusta Fermentasi, which is 14.4%, the highest protein content is from Kopi Lanang, which is 26.6%. The lowest fat content is in natural dry coffee, with a fat content of 4.3%.

Keywords: Carbohydrates, fat, protein, roasting machine

INTRODUCTION

Coffee is one of the most popular drinks that have good taste and aroma. Differences in temperature, climate, and environmental conditions of the coffee plants also affect the nutritional content of coffee (DaMatta et al., 2019). Some of these can affect the quality of the coffee beans. Coffee is not allowed to smell foul and not grow mold. In addition, the coffee taste is influenced by acidity, the delicious aroma, and the taste of the coffee and (Handayani, 2016). The processing influences the level of acidity and nutrient content in coffee carried out. The drying process and coffee roasting temperature can also affect the quality of the coffee products produced (Bauer et al., 2018).

Coffee products from Gedeong Koffee use a wet processing process to produce the coffee. Wet processing can be done for small-scale (farmer level) and medium-scale (semi-mechanical and

mechanical). Coffee cherries that are processed wetly must be ripe or red-picked (95% red fruit). As the wet log of the harvest, the coffee fruit has a moisture content of between 60-65%. Coffee beans are still protected by the skin of the fruit, pulp, mucus layer, horn skin, and epidermis. Coffee cherries that have just been harvested must be immediately sorted/separated between red, green, rotten, or damaged coffee cherries and dirt (De Azevedo et al., 2008). Gedong Kendal Village coffee group has six coffee variants (Kopi Rakyat, Kopi Lanang, Robusta Fermentasi, Robusta Fermentasi 1, Excelsa Natural Dry, Robusta Natural Dry).

The coffee cherries must be handled quickly into a more stable form so that they are safe to store for a certain period. The treatment largely determines seed quality criteria, including physical aspects, taste and cleanliness, and aspects of uniformity and consistency at each stage of the production process. Therefore, the process stages and specifications for coffee processing equipment that ensure quality must be clearly defined. The roasting behavior of raw beans results in changes in the texture characteristics of coffee, chemical, and physical changes. The roasting process will be relatively easier to control if the coffee beans have uniformity in size, texture, moisture content, and chemical structure (Pittia et al., 2007). Before the roasting process, coffee beans do not have the characteristic taste and characteristics of coffee and only contain flavor-forming precursor compounds. The characteristic taste of the coffee will be formed during the roasting process. The components in raw coffee beans are processed by a reasonably high thermal, usually 100-150oC (Klingel et al., 2020). The changes that appear in the coffee cherries that are initially white to brown due to the effects of nonenzymatic and pyrolysis (Nakilcioğlu-Taş & Ötleş, 2019).

In addition, the shape of the coffee has decreased in density and shows the typical brittleness of the roasted product. Achieving a certain degree of brittleness is essential in the grinding process, which is carried out on pre-roasted coffee beans. The coffee roaster, which is equipped with a temperature control system and rotation, is expected in the roasting process to be carried out quickly, and the coffee ripens evenly. Semi-automatic coffee roasting machines can help the middle to lower class society. Helping coffee entrepreneurs in the roasting work process (Rizka, 2020).

Conventional roasting using a frying pan as a roasting medium is considered adequate. The uneven heat of the pan can cause this. In addition, it can cause the level of ripeness and uniformity of the roasted coffee color to be difficult to obtain if the coffee beans are not continuously stirred during the roasting process. The runaway roasting temperature in conventional coffee processing can cause the spread of excess heat to the coffee beans and make the coffee beans black more quickly. Thus, the final quality will be difficult to maintain for each roasting process. Different temperatures and roasting times in the production process result in differences in the quality of the coffee produced (Saloko et al., 2019).

As water is measured during and after the roasting process, the measurements can predict the final mass of coffee. Air is a mixture of several gases, mainly nitrogen, oxygen, and water, with small amounts of argon, helium, and hydrogen. The amount of water in the air is described as air humidity. Depending on the temperature and pressure, air will be able to absorb more or less water. Hot air, such as in a coffee roaster, can evaporate liquid water into gaseous water. The phenomenon that occurs is that hotter air can hold more water than colder air.

Roasting results can affect the taste and nutrition of coffee. Therefore, data is needed to obtain water, carbohydrate, fat, and protein content to measure the quality of coffee beans. After the roasting process, this test is carried out roasting before being pollinated to determine the role and water content. Observation of quality changes that occur during processing must be carried out regularly to be corrected quickly and precisely if there is a quality deviation. Quality improvement efforts must be accompanied by a quality-oriented marketing mechanism to achieve optimal results (Hameed et al., 2020). The Godeng Kendal coffee association is given a roasting machine for roasting coffee bean products and analyzed for water, carbohydrate, protein and fat content.

METHOD

At post-harvest, coffee was sorted and continued with the coffee bean processing process

using a cylinder type roaster with 5 kg for a process control system so that coffee beans are roasted according to the target cooking level with an average temperature of 200oC several time. A coffee roasting machine uses a 1/2 HP electric motor so that household electric power can use this machine without adding electric power. With complete specifications in Table 1, while the design and accurate in figure 1. The roasting Machine was a gift from the Community Service team.

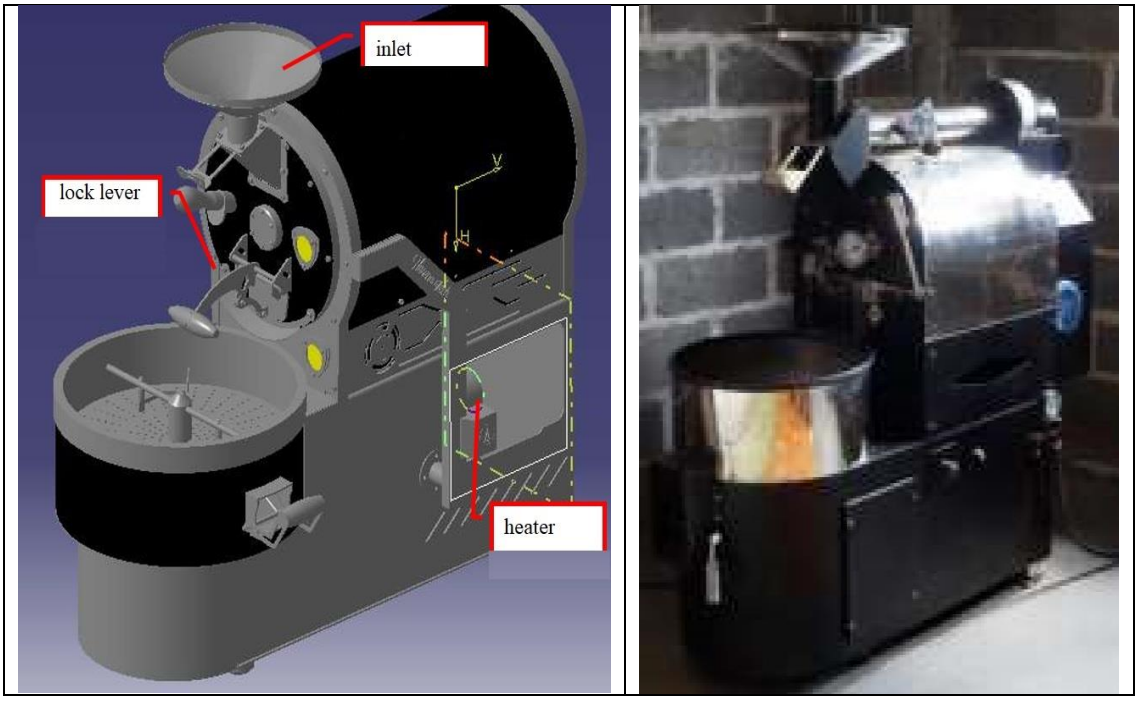
Packaging is a process to cover products with various types and quality levels such as original, fermium, and classic. Processed coffee products in the packaged form are marketed through storage activities at various supermarkets, exhibition activities, and some even come directly to buy or order online. The test was conducted descriptively, with each treatment being repeated three times.

The data from the analysis results are presented in illustrated tables and graphs to facilitate the interpretation of the data. The process and stages of the testing stages are carried out by roasting the peeled coffee and then testing the sample's water content. The roasted sample is then tested for its proximate content. Proximate analysis is a test carried out to determine the nutritional content in products, such as carbohydrates, proteins, and fats (Daning & Karunia, 2018). Proximate analysis in this study aims to determine the value of carbohydrates, proteins, and fats from Gedong Kendal Coffee.

This research was conducted at the Laboratory of the Department of Biology, Universitas Negeri Semarang. The raw materials in this study were ground coffee from Patean Kendal consisting of Kopi Rakyat, Kopi Lanang, Robusta Fermentasi, Robusta Fermentasi 1, Excelsa Natural Dry, Robusta Natural Dry. d accurate picture in Figure 1. The roasting Machine was a gift from the Community Service team. The chemicals used in this test include H2SO4, NaOH, EDTA, CTAB, K2SO4, Na2SO4, Technical Acetone, CuSO3, Boric Acid (H3BO3), Mengsel indicators, Petroleum Benzen, NaOH, Ethanol, K-Na Tartarate, and Aquades. The equipment used in this study included aluminum foil, oven, glassware, vacuum pumps, furnaces, electric stoves, 2G-3 and 2G-4 glass filters, analytical balances, burette tubes, distillation, and Kjeldahl tubes.

Table 1. Specifications of Roasting Machines for coffee beans donated by the Community Service Team

Subject	Description
Drum Capacity	5kg/Batch, Min 500 G Max 5,5kg
Drum Speed	Automatic & Adjustable
Heat Source	Gas (LPG)
Heating System	Indirect
Burner Type	Semi Infrared
Burner System	Ignition Automatic
Pre Heating	12Minutes
Roasting Tim	8-12 Minutes
Cooling Time	3-5 Minutes
Environmental Temperature	Digital Suport Data Logger, Set Default: 35°C
Bean Temperature	Digital Suport Data Logger, Set Default: 220°C
Cooling Bean	Yes
Agitator	Yes



(a) (b)

Figure 1. (a) Design, and (b) Coffee roaster

RESULT AND DISCUSSION

Coffee roasting process The manufacture of controlled roasting machines aims to save energy as well as cost and time efficiency. The rotation control system on this coffee roaster uses PWM to regulate the speed of the DC motor with its components as the rotation regulator, the incoming voltage from the power supply, and the voltage out of the motor. The temperature control system uses a thermocouple, solenoid valve, and manual faucet. The control system uses a rotation (60 rpm) with a temperature of nearly 200oC for 25 minutes. The result has shown a decrease in the moisture content of the coffee beans by 10.7% and the color of the coffee beans turning brown. The test results show that there is a process of transferring heat and mass of water from the appliance to the coffee beans during the roasting process. Coffee beans experience a decrease in moisture content when roasting (Pittia et al., 2007). The longer the roasting time, the faster the heat of food waste is transferred and the faster the evaporation of water from the foodstuffs. The moisture content meets the SNI 01-2907-2008 requirements, that coffee beans have a maximum content of 12.5%. If the water content exceeds this number, there is a big chance for mold and mold to grow.

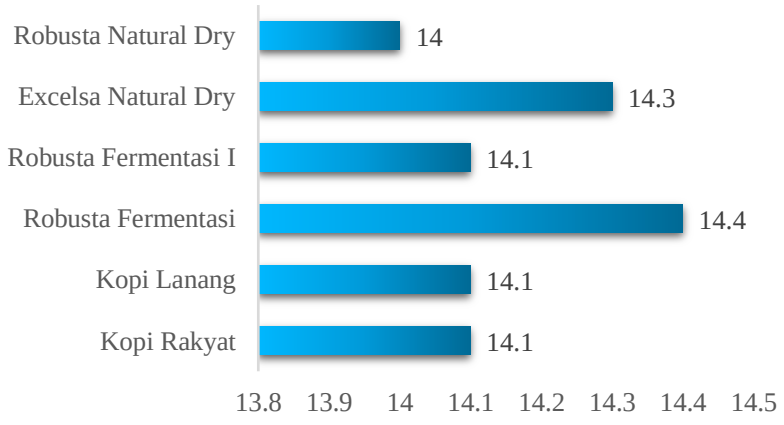


Figure 2. Gedong Koffee Sample Carbohydrate Content

Figure 2 shows the carbohydrate content of coffee products from Gedong Kopi Kendal, which is almost the same in the range of 14%. However, the product with the highest carbohydrate content is the Robusta Fermentasi coffee type of 14.4%. In unroasted green coffee beans, carbohydrates represent a large proportion of the structural elements, as much as 50%. These carbohydrates consist of other chemically soluble substances such as mono, oligo, and polysaccharides. The carbohydrates in green coffee beans change during the roasting process—all elements in the coffee bean change in varying amounts depending on the roast level. In light roasts with temperatures approaching 200oC, the process of losing moisture reaches 3-5%.

The initial stage of roasting is to remove moisture when the roasting temperature reaches 100° C and the next stage is pyrolysis at 180° C. At the pyrolysis stage, changes in chemical composition and weight reduction of 10% occur. Changes in physical and chemical properties (Maillard Reaction) occur during the roasting process, such as swelling, evaporation of water, formation of volatile compounds. Sugar compounds will be caramelized to give a distinctive aroma. Compounds that cause a sharp or sour taste, such as tannins and acetic acid, will be lost, and some will react with amino acids to give a brown color. The reaction that occurs was reducing crude fiber and denaturing the protein. The forming CO2 gas is a result of oxidation and helping to form a characteristic aroma in coffee. It also causes the number of carbohydrates to decrease into shorter compounds and some to evaporate. The physical condition of the coffee beans expands during roasting due to the formation of gases, which primarily consist of CO2, then these gases fill the spaces in the cells or pores of coffee (Fadai et al., 2017). The carbohydrate content after roasting is around 14,4%. That refers to the explanation that carbohydrates in roasted coffee beans are present as polysaccharides (extractable or non-extractable). A fraction of the carbohydrates in the extract can be recovered as oligomers and up to monomers. During roasting, the polysaccharide was reduced due to degradation. A former product is low molecular weight carbohydrates (i.e., mono and oligosaccharides) and more extractable. Various methods that can be used to extract carbohydrates from roasted coffee are sequential extraction, acid hydrolysis, hot water extraction, and enzymatic extraction.

Protein Content

The lowest protein content is 9.5% in fermented robusta. This figure is almost the same as the achievement of roasted coffee beans, which reduced their protein content by 8.7-12.2% (Kitzberger et al., 2006). It is pretty different from Sidama coffee, which after being roasted, the protein content ranges from 13.12 to 14.18%. If observed in Figure 3, the highest protein content is found in people's coffee after roasting at 26.584%. The optimal temperature and time to reach the highest protein content were 190 ° C and 6 minutes, respectively, which resulted in protein content of 13.69% (Endeshaw & Belay, 2020). Before roasting, coffee beans have higher protein levels in the form of amino acids (Donk et al., 2015). Coffee must be roasted to reveal its taste. Green coffee beans contain all the necessary ingredients for the development of coffee flavor. Amino acids and free peptides are needed to produce the aroma of coffee. Coffee beans were observed to acquire the potential to spontaneously release H (2) O (2) after polymerization and protein fragmentation during roasting. The biochemical mechanisms of roasting involve both autoxidation and redox (Montavon et al., 2003).

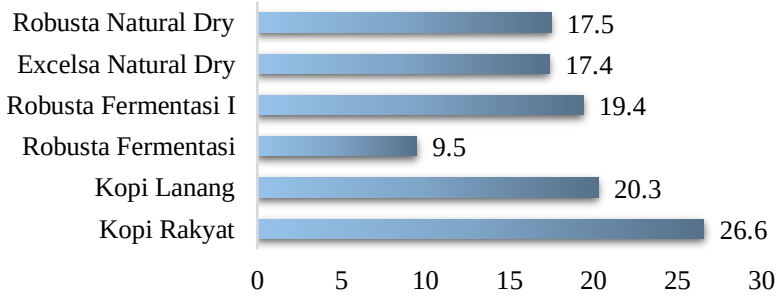


Figure 3. Protein Content of Gedong Koffee Sample

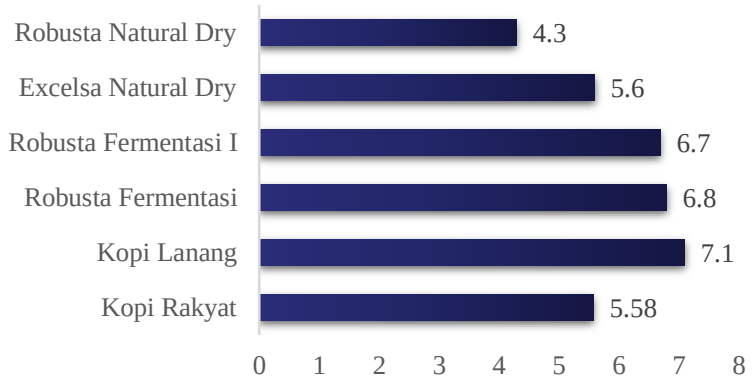


Figure 4. Gedong Coffee Fat Content after roasting

Fat content

The fat reduction factor generally occurs during the roasting process. The fat content that is still contained in the coffee beans will evaporate with the length of the roasting process. The longer the roasting process is carried out, the fatty acids will evaporate from the coffee beans. The following is a graph of the fat content contained in the coffee bar. The fat content in Gedong Kendal coffee with a fat content of 4.3-7.1% is shown in Figure 4. The lowest fat content is owned by natural dry coffee, while the highest content is in lanang coffee. The fat content of Sidama coffee after roasting was higher in the range of 11.04-17.28%. The higher the temperature in the sangria process, the fat tends to be. The corresponds to the fat content of coffee beans increasing with roasting temperature due to the degradation of carbohydrates and the evaporation of volatile chemicals (Liu and Kitts, 2011). The fat content of roasted Sidama coffee is higher than Harar and Berry coffee beans. Ultimately healthy ripe coffee beans have a higher oil content than damaged coffee beans (Oliveira et al., 2006).

Thus, Sidama Coffee is classified as good quality coffee. The optimal roasting temperature and time to achieve better fat formation is 190 ° C at 6 minutes, which results in 14.42% (Endeshaw & Belay, 2020). Besides being influenced by the roasting process, the fat content in natural dry coffee is influenced by the processing technique. Gedong coffee uses a wet processing process. Wet processing is quite helpful to reduce the fat content in the coffee beans. The principle of wet processing uses water for stripping and washing the coffee cherries (Haile & Kang, 2019). Wet coffee processing produces coffee beans with better quality, only takes longer than dry processing (Kustiasari et al., 2018).

CONCLUSION

Testing the coffee beans produced by Gedong Patean Kendal after experiencing sangria approaching 200oC showed a water content of 10.7%. Chemical properties can be tested with the highest carbohydrate results found in fermented coffee, 14.4%. The highest protein content is in people's coffee, which is 26.6%, and the lowest fat content is in natural dry coffee with a fat content of 4.3%. The content of each coffee is different, and this is influenced by the production process carried out and the temperature conditions, soil type, and the climate of the production environment. The roasting affects changes in bitter taste and aroma, resulting from volatile compounds from the addition and subtraction of carbohydrates, protein, and fat content.

REFERENCES

Bauer, D., Abreu, J., Jordão, N., Rosa, J. S. D., Freitas-Silva, O., & Teodoro, A. (2018). Effect of roasting levels and drying process of Coffea canephora on the quality of bioactive compounds and cytotoxicity. International journal of molecular sciences, 19(11), 3407.

DaMatta, F. M., Rahn, E., Läderach, P., Ghini, R., & Ramalho, J. C. (2019). Why could the coffee crop endure climate change and global warming to a greater extent than previously estimated?. Climatic Change, 152(1), 167-178.

Daning, D. R. A., & Karunia, A. D. (2018). Teknologi Fermentasi Menggunakan Kapang Trichoderma sp untuk

Meningkatkan Kualitas Nutrisi Kulit Kopi sebagai Pakan Ternak Ruminansia. AGRIEKSTENSIA: Jurnal Penelitian Terapan Bidang Pertanian, 17(1), 70-76.

De Azevedo, A. B. A., Mazzafera, P., Mohamed, R. S., Melo, S. A. B., & Kieckbusch, T. G. (2008). Extraction of caffeine, chlorogenic acids and lipids from green coffee beans using supercritical carbon dioxide and co-solvents. Brazilian Journal of Chemical Engineering, 25(3), 543-552.

Endeshaw, H., & Belay, A. (2020). Optimization of the roasting conditions to lower acrylamide content and improve the nutrient composition and antioxidant properties of Coffea arabica. Plos one, 15(8), e0237265.

Fadai, N. T., Melrose, J., Please, C. P., Schulman, A., & Van Gorder, R. A. (2017). A heat and mass transfer study of coffee bean roasting. International Journal of Heat and Mass Transfer, 104, 787-799.

Haile, M., & Kang, W. H. (2019). The harvest and post-harvest management practices' impact on coffee quality. Coffee-Production and Research, 1-18.

Hameed, A., Hussain, S. A., & Suleria, H. A. R. (2020). "Coffee bean-related" agroecological factors affecting the coffee. Co-Evolution of Secondary Metabolites, 641-705.

Handayani, B. R. (2016). Coffee and its flavor. Jurnal Ilmiah Rekayasa Pertanian dan Biosistem, 4(1), 222-217.

Kitzberger, C. S. G., Scholz, M. D. S., Pereira, L. F. P., Silva, J. B. G. D., & Benassi, M. T. (2016). Profile of the diterpenes, lipid and protein content of different coffee cultivars of three consecutive harvests. AIMS Agriculture and Food, 1(3), 254-264.

Klingel, T., Kremer, J. I., Gottstein2, V., Rajcic de Rezende, T., Schwarz, S., & Lachenmeier, D. W. (2020). A review of coffee by-products including leaf, flower, cherry, husk, silver skin, and spent grounds as novel foods within the European Union. Foods, 9(5), 665.

Kustiasari, T., Setyoko, U., Arieni, D., & Prayitno, P. (2018). Arabica Coffee Bean Quality Test With Wet Processing (Full Wash Processing) System At" Sejahtera Bersama" Farmers Group, Panti Sub-District, Jember Regency, East Java. In Proceeding of the 1st International Conference on Food and Agriculture, 46-54.

Liu Y, & Kitts DD. Confirmation that the Maillard reaction is the principle contributor to the antioxidant capacity of coffee brews. Food Research International. 2011 Oct 1;44(8):2418–24.

Montavon, P., Mauron, A. F., & Duruz, E. (2003). Changes in green coffee protein profiles during roasting. Journal of Agricultural and Food Chemistry, 51(8), 2335-2343.

Nakilcioğlu-Taş, E., & Ötleş, S. (2019). Physical characterization of Arabica ground coffee with different roasting degrees. Anais da Academia Brasileira de Ciências, 91(2).1-15.

Oliveira, L. S., Franca, A. S., Mendonça, J. C., & Barros-Junior, M. C. (2006). Proximate composition and fatty acids profile of green and roasted defective coffee beans. LWT-Food Science and Technology, 39(3), 235-239.

Pittia, P., Nicoli, M. C., & Sacchetti, G. (2007). Effect of moisture and water activity on textural properties of raw and roasted coffee beans. Journal of texture studies, 38(1), 116-134.

Rizka, M. (2020, May). The Effectiveness of Coffee Bean Processing Machines in the Rezeki Farmers Group in Takengon, Central Aceh. In IOP Conference Series: Materials Science and Engineering (Vol. 854, No. 1, p. 012069). IOP Publishing.

Saloko, S., Sulastri, Y., Murad, & Rinjani, M. A. (2019, December). The effects of temperature and roasting time on the quality of ground Robusta coffee (Coffea robusta) using Gene Café roaster. In AIP Conference Proceedings (Vol. 2199, No. 1, p. 060001). AIP Publishing LLC