VOLUME 15, NOMOR 2 JUNI 2021

ISSN: 1907-8056
e-ISSN: 2527-5410

AGROINTEK

JURNAL TEKNOLOGI INDUSTRI PERTANIAN

JURUSAN TEKNOLOGI INDUSTRI PERTANIAN
UNIVERSITAS TRUNOJOYO MADURA

Volume 15 No 2 June 2021 ISSN : 1907 –8056
e-ISSN : 2527-5410

AGROINTEK: Jurnal Teknologi Industri Pertanian

Agrointek: Jurnal Teknologi Industri Pertanian is an open access journal published by Department of Agroindustrial Technology,Faculty of Agriculture, University of Trunojoyo Madura. Agrointek: Jurnal Teknologi Industri Pertanian publishes original research or review papers on agroindustry subjects including Food Engineering, Management System, Supply Chain, Processing Technology, Quality Control and Assurance, Waste Management, Food and Nutrition Sciences from researchers, lecturers and practitioners. Agrointek: Jurnal Teknologi Industri Pertanian is published four times a year in March, June, September and December.
Agrointek does not charge any publication fee.

Agrointek: Jurnal Teknologi Industri Pertanian has been accredited by ministry of research, technology and higher education Republic of Indonesia: 30/E/KPT/2019. Accreditation is valid for five years. start from Volume 13 No 2 2019.

Alamat Redaksi
DEWAN REDAKSI JURNAL AGROINTEK
JURUSAN TEKNOLOGI INDUSTRI PERTANIAN
FAKULTAS PERTANIAN UNIVERSITAS TRUNOJOYO MADURA
Jl. Raya Telang PO BOX 2 Kamal Bangkalan, Madura-Jawa Timur
E-mail: Agrointek@trunojoyo.ac.id

p-ISSN: 1907-8056
e-ISSN: 2527-5410
AGROINTEK
Agroindustrial Technology
journal homepage: journal.trunojoyo.ac.id/agrointek

SENSORY PROPERTIES OF ANALOG COFFEE FROM BANANA PEELS

Umar Hafidz Asy'ari Hasbullah*, Allikha Bias Mentari, Siti Nur Kholisoh, Taufik Nor Hidayat

Teknologi Pangan, Fakultas Teknik dan Informatika, Universitas Pendidikan PGRI Semarang

Article history
Diterima:
27 Desember 2019
Diperbaiki:
19 Juni 2020
Disetujui:
28 Agustus 2020

Keyword
Analog coffee; banana peel; sensory; descriptive

ABSTRACT

Banana peel had the potential to be used as analog coffee. The sensory of analog coffee will determine consumer acceptance and potential for production. This research aims to study the effect of banana peel maturity and the length of the oven on the sensory characteristics of banana peel analog coffee. Ripe and unripe Kepok banana peels were dried and then baked in the oven with time variations of 5, 10, and 15 minutes/ 50 gram. Then it was reduced in size and sieved with 60 mesh. The sensory test was used hedonic were performed by untrained panelists and descriptive methods were performed by the first training panelists. The results were showed that the panelists' preference towards color and aroma of analog coffee powder increased with the length of baking time. The preference for ripe banana peel analog coffee was greater than that of unripe banana peel. The panelists' preference for the color, aroma, and taste of brewed analog coffee was increased with longer baking time. The flavor of brewed analog coffee of ripe banana peel was stronger than that of the unripe peel. The most preferred banana peel coffee was ripe banana peel baked at 180°C for 15 minutes. It was showed characteristics of darker color and a stronger aroma of coffee powder. The most preferred brewing analog coffee was that with the darkest color, the coffee's strongest aroma, and the strongest bitter taste.

* Penulis korespondensi
Email : umarhafidzah@gmail.com
DOI 10.21107/agrointek.v15i2.6219

INTRODUCTION

Banana peels constitute 30% of the inedible portion (González-montelongo et al. 2010). This part is generally only thrown in the trash. Whereas in industries that process bananas, the peel is usually collected and taken by farmers to be used as feed. This is a challenge to develop banana peels into food products.

Banana peels have been made into analog coffee by using peel from ripe and unripe bananas (Mentari et al., 2019; Sofa et al. 2019). Making analog coffee consists of reducing the size of the peel, drying, curing, grinding, and sieving. Banana peel coffee is proven to contain phenol antioxidant compounds and has antioxidant activity, as evidenced by testing with DPPH radical compounds (Mentari et al. 2019).

Therefore, banana peel coffee has the potential to be developed and developed on a production scale. But a product is worth trading if consumers like it (Sidel & Stone 1993). The role of consumers is very important in testing product acceptance in the market (Costa & Jongen 2006). This research aims to study the consumer preference characteristics represented by panelists on banana peel coffee. It also to explore the descriptive profile of banana peel coffee.

METHODS

Materials and Tools

The main ingredients were used Kepok banana peel (unripe and ripe) obtained from Karangawen, Demak, Central Java. Material for sensory analysis was used drinking water and standards for descriptive testing. The tools were used cabinet dryer, blender, 60 mesh sieve, shot glass.

Experiment Design and Data Analysis

The research design was used a randomized factorial design, with the first factor being the difference in the level of fruit maturity that was unripe and ripe. The second factor was 5, 10, and 15 minutes of oven. Hedonic data were analyzed using Anova, while comprehensive data were analyzed using Pearson product-moment. Both of these were analyzed using SPSS 16 software.

Banana Peel Preparation

Kepok banana peel was separated from the fruit flesh. Then it was reduced in size (2 x 2 cm) and spread in a pan. Furthermore, it was dried in a cabinet dryer at 60ºC for 24 hours. The dried sample was stored in airtight plastic to the treatment stage.

Making Banana Peel Coffee

Fifty grams of dried banana peels were baked in an oven at 180 ºC for 5, 10, and 15 minutes. The sample was mashed with a dry blender, furthermore, sieved with a 60 mesh sieve. The analog coffee sample powder was stored in aluminum foil packaging until analysis.

Sensory Hedonic Analysis

Consumer preference was assessed by the hedonic method. The number of panelists were used was 25 people. The criteria of the panelists chosen were not trained. The panel was asked to rate the favorite score of banana peel coffee powder on the color and aroma parameters. While brewing coffee was assessed on the parameters of color, aroma, taste, and overall. Scores used were 1-6, were 1 (very dislike) - 6 (very like).

Sensory Descriptive Analysis

Profile description of coffee powder and brewing of banana peel were analyzed with descriptive method. Twenty-five panelists were trained and introduced to the standards and intensity of each parameter. After the panelists were familiar with all the assessment attributes, a profile of coffee powder and coffee brewing was tested. The intensity scale ranged from 1-10. The assessment parameters of the powder consisted of coffee aroma, banana aroma, caramel aroma, and dark color. While the brewing parameters tested consisted of banana aroma, caramel aroma, coffee aroma, bitter taste, sweet taste, astringent taste, sour taste, and dark color.

RESULTS AND DISCUSSION

Sensory Hedonic Characteristics

The hedonic test was carried out on banana peel coffee powder. This test was intended to determine the level of preference of panelists towards banana peel coffee powder. The difference in the level of maturity and length of the oven had a significant influence on the hedonic score of the coffee powders of banana peels in several treatments (Figure 1). Coffee was derived from unripe banana peels shows the panelists' preference for powder colors that were significantly different from coffee from ripe banana peels. The duration of the oven processing of unripe banana peel did not have a significantly

different effect on panelists' preference for the color of coffee powders. This was different from coffee from the ripe banana peel, which showed the panelists' liking score of the powder color, which was significantly different from the difference in oven duration. Panelists said they preferred the color of coffee produced from ripe banana peels.

The color of the dried banana peel will turn light to dark brown during 5 minutes and 10 minutes oven respectively. In contrast, a 15-minute oven produces dark brown powder. This change in color to brown and dark is due to non-enzymatic browning. Maillard and caramelization reactions occur during curing at high temperatures. Banana peels contain reducing sugars such as glucose, fructose, and maltose (Chandraju et al. 2011). The total sugar content is 29%. Glucose content is 2.4%, fructose 6.2%, and sucrose 2.6% (Mohapatra et al. 2010).

Meanwhile, according to Emaga et al. (2007), sugar content in ripe banana peel does not contain sucrose but contains 15% glucose and 26% fructose. Banana peels contain 38% free sugar (Emaga et al. 2011). The protein content in banana peels is 1.8%. The dominant amino acid content in banana peels includes Leucine, Valine, Phenylalanine, and Threonine. Total amino acids range from 4.3% to 8.1% (Emaga et al. 2007). The sugar and amino acids in banana peels are a precursor of the Maillard reaction and caramelization. Maillard's reaction occurs because of the reaction between reducing sugars and amino acids at high temperatures. In contrast, caramelization occurs in total sugar at high temperatures. Both of these reactions produce brown compounds. Maillard's reaction produces melanoidin, which has a high molecular weight, which causes brown and dark colors (Coghe et al. 2006). Increasing the temperature and the longer the heating will cause the formation of compounds 5-(hydroxymethyl)-2-furfural (HMF) more and more. HMF will condense and form high molecular weight polymers that make a brown color called melanoidin (Agila & Barringer 2012). Caramelization produces brown polymer compounds (Ajandouz et al. 2001). Warming sugar at high temperatures will cause the sugar to melt to form a dark brown viscous liquid called caramel. Caramelization involves the formation of glucose and fructose anhydrides, which will condense into caramelan and caramelan. These two compounds will condense to form humin or caramelin (Narasimman & Prabhakaran 2012); Araújo et al. 2019).

The difference in the level of maturity of the banana peel caused the panelists' favorite score for the aroma of coffee powder to be significantly different in the oven lengths of 10 and 15 minutes (Figure 2). The size of the oven showed no significant difference in the score of coffee powder flavor. Panelists prefer the aroma of coffee powders produced from ripe banana peels.

The aroma of banana peel coffee was formed during the oven process. Maillard and caramelization reactions occur at the oven temperature and produce volatile compounds that contribute to the scent of the coffee powders produced. Maillard reactions will produce volatile compounds such as furans, pyrazines, pyrroles, oxazoles, thiophenes, thiazoles, and other heterocyclic compounds that contribute to the aroma (Mottram 1994; Yanagimoto et al. 2002). The furan-2-carbaldehyde (furfural) compound describes an almond-like scent. The 4-hydroxy-5-methyl furan-3-one (HMF) compound contributes to the sweet aroma (Lee et al. 2010). The 2-isobutylpyrazine compound contributes to the aroma of pepper. The 1H-pyrrole-2-carboxylic acid compound contributes to the roast aroma. The 4-butyl-2,5-dimethylthiazole compound contributes to the aroma of fry (Zou et al. 2019). Pyrazine compounds contribute to the aroma of roasted and nutty (Vázquez-Araújo et al. 2009). In contrast, the caramelization reaction produces volatile compounds such as furan moieties and carbonyl groups (Tomasik & Jane 1995).

Coffee brewing was made by dissolving 5 grams of coffee powder into 100 ml of water at 95°C, then stirring and filtering. Brewing was tested at warm, serving temperatures to the panelists. Panelists favor of brewing banana peel coffee was tested on the parameters of color, aroma, taste, and overall brewing (Figure 3). The difference in the level of maturity caused the panelists to give a significantly different preference score for the color of the brewed coffee brew (Figure 3A). The length of the oven had a significantly different effect on panelists' preference for the color of brewed banana coffee brewing, while on raw brewed coffee, brewing was not significantly different. Panelists tended to like the color of brewed coffee from an unripe banana peel.

The panelists' preference for the aroma of coffee brewing was not significantly different at different levels of maturity (Figure 3B). The length of time of the oven has a tendency not to cause any real difference to the panelists' preference for the aroma of brewing banana peel coffee. Even so, panelists tend to like the aroma of brewing banana peel coffee brewing compared to unripe banana peel coffee brewing.

The difference in the level of maturity did not have a significantly different effect on panelists' preference for the taste of brewing banana peel coffee (Figure 3C). The length of time of the oven has a tendency not to cause a noticeable difference in the panelists' preference for the taste of coffee brewed unripe and ripe bananas. Even so, the score of the sweetness taste of brewed banana peel coffee brewing tends to be higher than that of unripe banana peel coffee brewing. This shows that panelists prefer the taste of ripe banana peel coffee.

Overall, panelists assessed that preference for brewed and unripe banana peel coffee was not significantly different (Figure 3D). Differences in the level of maturity and length of covenants tend not to cause statistical differences in preference. However, the panelists' preference scores tend to be higher than brewed banana peel coffee brew than unripe ones. This means that coffee brewed on a ripe banana peel is preferred by panelists.

Powder Sensory Descriptive Characteristics

The descriptive profile of banana peel analog coffee was showed by a descriptive test with trained panelists. Banana peel analog coffee powder has a sensory profile shown in the parameters of color and aroma (Figure 5). The descriptive profile of unripe banana peel coffee powder has a not too dark brown color (Figure 4). Whereas ripe banana peel analog coffee powders tend to have a darker color. Sugar content such as sucrose and reducing sugar in ripe banana peels may be higher than unripe bananas (Emaga et al. 2007). Sucrose and reducing sugar will undergo caramelization at the oven temperature above 180°C. On the other hand, reducing sugars will react with amino acids contained in the peel so that the Maillard reaction occurs, which produces melanoidin brown. Besides carbon compounds such as cellulose that make up ripe banana peels will undergo pyrolysis at high temperatures so that the color becomes blackish.

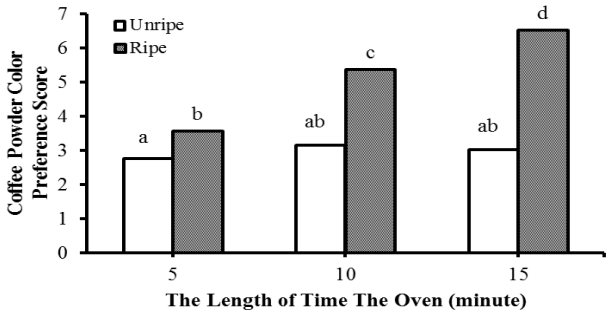

Figure 1 A panelist's preference for the color of banana peel coffee powders. Different notation shows significant difference at α = 0.05. Values are the mean of 25 panelists (n = 25). Preference score 1 (very dislike) - 6 (very like).

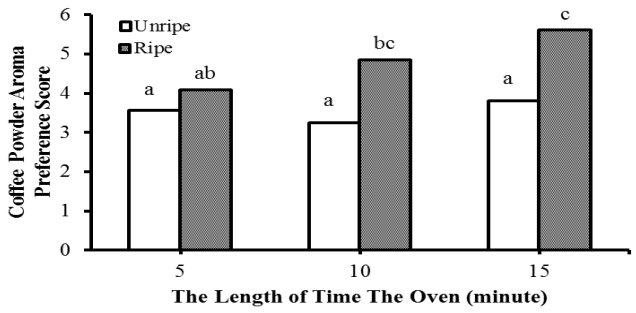

Figure 2 A panelist's preference for the aroma of coffee powders in a banana peel. Different notation shows significant difference at α = 0.05. Values are the mean of 25 panelists (n = 25). Preference score 1 (very dislike) - 6 (very like).

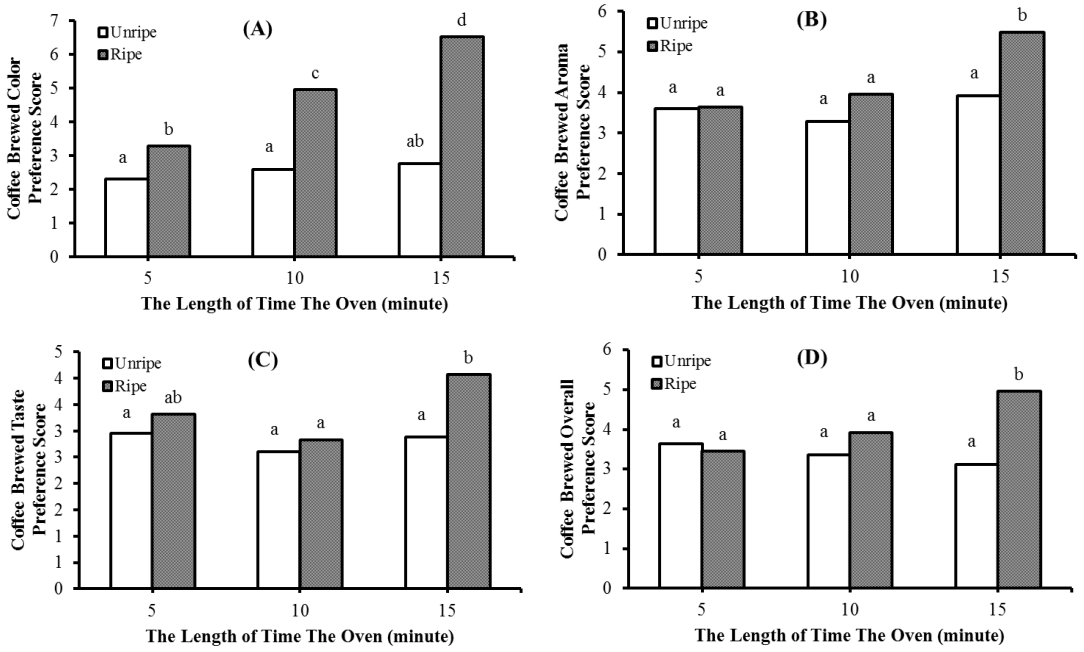

Figure 3 A panelist's preference for brewing banana peel coffee. (A) The color of brewing, (B) The aroma of brewing, (C) The taste of brewing, (D) Overall brewing. Different notation shows significant difference at α = 0.05. Values are the mean of 25 panelists (n = 25). Preference score 1 (very dislike) - 6 (very like).

The longer oven time causes the coffee color to darken. This is related to the internal temperature of the material, which increases with the time of the oven. The longer the temperature was exposed to the material, will cause thermal degradation so that the caramelization reaction, the Maillard reaction, and pyrolysis occur more intensely. The result will cause brown and dark colors to increase in intensity.

The aroma of coffee was increased in intensity with a longer time of oven on ripe banana peels. Many of the coffee's volatile aroma compounds can form from the Maillard reaction process and caramelization on ripe banana peels. The aroma of bananas tends to be non-dominant and slightly decreases in intensity with more extended curing. In contrast, the aroma of caramel tends to be stable.

Brewed Sensory Descriptive Characteristics

Descriptive profiles of banana peel coffee brewing were showed in the parameters of color, aroma, and flavor of the brewing (Figure 6). The profile of brewing analog coffee of unripe banana peels shows that the longer the curing causes the brewing color to darken (Figure 6a). Besides, the longer oven produces the aroma of caramel and the aroma of coffee to increase. The scent of a banana tends not to change.

Ripe coffee brewing profile showed that the longer the oven time, the darker the brewing color (Figure 6b). The dark color appears to have a higher dark intensity than brewing from raw banana peels (Figure 7). This is possible because of the amount of melanoidin, caramelan, caramelen, and carbon compounds that burn more in ripe banana peel coffee. Mature banana peels contain more non-enzymatic browning precursor compounds such as sugar and amino acids. The aroma profile of coffee increases in intensity with the length of time of the oven. This was made possible by the longer oven causing more coffee aroma formation reactions to occur to produce more volatile coffee aroma compounds. The bitter taste profile of coffee was increased with the length of time of the oven. This is possible because of the intensive reaction of the degradation of components in a banana peel during covenant, which results in an increased bitter taste.

The brewing process was carried out by dissolving as much as 5 grams of coffee in 100 ml of hot water. The brewing process will dissolve the water-soluble compounds and will leave insoluble compounds such as pulp. The colored compounds will dissolve, causing the brewing color to become more concentrated and dark (Figure 7). Brewing

will increase the aroma of brewing because it is evaporated with water that evaporates at high temperatures. Besides, volatile aroma compounds will evaporate at high temperatures when brewed with hot water.

Correlation of Sensory, Physical and Chemical Properties

The relationship between various parameters as indicated by the Pearson correlation value (Table 1). The results of correlation analysis showed the relationship between hedonic powder scores and coffee brewed banana peels showed a significant and robust closeness in all parameters, except for the taste parameters. This was indicated by the coefficient value that is close to one. The coefficient value shows a positive value, which means the close relationship between the two is synergistic. If the hedonic powder score increases, the brewing hedonic score also increases and vice versa.

The relationship between hedonic powder with a descriptive profile of dark color and the aroma of coffee powder showed very closely and significantly. The relationship has a positive relationship. This can be interpreted as increasing the intensity of dark colors and the aroma of coffee powder. The hedonic score will also increase.

The relationship between hedonic brewing with a descriptive profile of dark colors, coffee aroma, bitter taste, and brewing sour taste showed very closely and significantly. This was indicated by the coefficient value that is close to one. The close relationship between the two was showed by the positive coefficient value, which means the increasing intensity of dark colors, coffee aroma, bitter taste, and a sour taste in brewing, hedonic brewing scores will also increase.

The relationship between the content of phenol compounds with hedonic brewing colors, hedonic colors and powder aroma, descriptive profiles of color and powder aroma, descriptive profiles of dark colors, and caramel aroma showed very close and significant. The closeness was indicated by a positive coefficient value. This showed that if the phenol compound content increases, it causes hedonic brewing color, hedonic color, and powder aroma, descriptive color profile and powder aroma, descriptive color profile dark, and caramel brewing aroma will also increase.

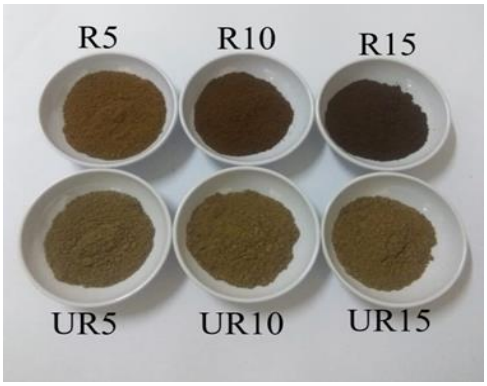

Figure 4 Banana peel coffee powder. R (ripe banana peel), UR (unripe banana peel), 5,10,15 (minutes of the oven)

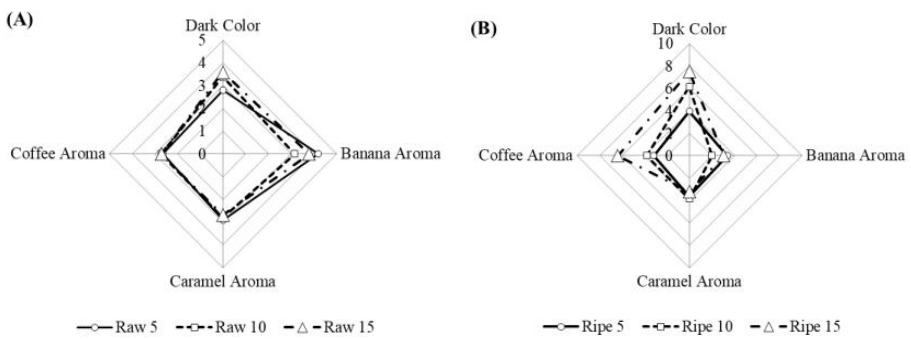

Figure 5 Sensory profile of banana peel coffee powder. (A) Unripe banana peel coffee powder, (B) Ripe banana peel coffee powder, Value is the average of 25 panelists (n = 25).

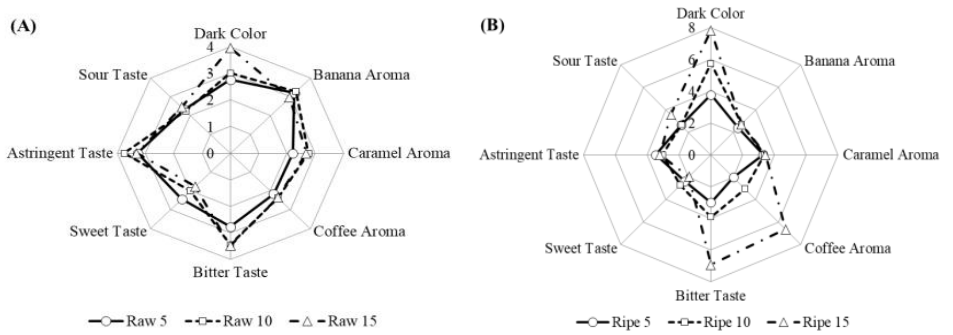

Figure 6 Sensory profile of brewing banana peel coffee. (A) Brewing of unripe banana peel coffee, (B) Brewing of ripe banana peel coffee. Value is the average of 25 panelists (n = 25).

Figure 7 Coffee brewed banana peel. R (ripe banana peel), UR (unripe banana peel), 5,10,15 (minutes of the oven).

CONCLUSION

The treatment that had the highest level of preference based on the hedonic test was oven banana peel coffee at 180°C for 15 minutes. This treatment powder profile had the darkest color, the strongest coffee aroma, the aroma of banana and caramel the same as other treatments. The brewing profile of this treatment had the darkest color, the strongest coffee aroma, and the bitter taste most felt compared to other treatments.

REFERENCES

Agila, A. Barringer, S., 2012. Effect of Roasting Conditions on Color and Volatile Profile Including HMF Level in Sweet Almonds (Prunus dulcis). *Journal of food science*, 77(4), pp.C461–C468. Available at: https://doi.org/10.1111/j.1750-3841.2012.02629.x.

Ajandouz, E.H., Tchiakpe, L.S., Ore, F.D., Benajiba, A. and Puigserver, A., 2001. Effects of pH on caramelization and Maillard reaction kinetics in fructose-lysine model systems. *Journal of Food Science.* 66(7). pp.926-931..

De Araújo, M.J.G., Villarroel-Rocha, J., De Souza, V.C., Sapag, K. and Pergher, S.B.C., 2019. Carbon foams from sucrose employing different metallic nitrates as blowing agents: Application in CO2 capture. *Journal of Analytical and Applied Pyrolysis.* 141. p.104627.

Chandraju, S., Mythily, R. Kumar, C.S.C., 2011. Extraction, isolation and identification of sugars from banana peels (Musa sapientum) by HPLC coupled LC/MS instrument and TLC analysis. *J. Chem. Pharm. Res.*, 3(3), pp.312–321.

Coghe, S., Gheeraert, B., Michiels, A. and Delvaux, F.R., 2006. Development of Maillard reaction related characteristics during malt roasting. *Journal of the Institute of Brewing.* 112(2). pp.148-156..

Costa, A.I.A. Jongen, W.M.F., 2006. New insights into consumer-led food product development. *Trends in Food Science & Technology*, 17(8), pp.457–465. Available at: https://doi.org/10.1016/j.tifs.2006.02.003.

Emaga, T.H., Andrianaivo, R.H., Wathelet, B., Tchango, J.T. and Paquot, M., 2007. Effects of the stage of maturation and varieties on the chemical composition of banana and plantain peels. *Food chemistry*, 103(2), pp.590–600. Available at: https://doi.org/10.1016/j.foodchem.2006.09.006.

Emaga, T.H., Bindelle, J., Agneesens, R., Buldgen, A., Wathelet, B. and Paquot, M., 2011. Ripening influences banana and plantain peels composition and energy content. *Tropical animal health and production*, 43(1), pp.171–177. Available at: https://doi.org/10.1007/s11250-010-9671-6.

González-montelongo, R., Lobo, M.G. González, M., 2010. Antioxidant activity in banana peel extracts : Testing extraction conditions and related bioactive compounds. *Food Chemistry*, 119(3), pp.1030–1039. Available at: http://dx.doi.org/10.1016/j.foodchem.2009.08.012.

Lee, S.M., Jo, Y.J. Kim, Y.S., 2010. Investigation of the Aroma-Active Compounds Formed in the Maillard Reaction between Glutathione and Reducing Sugars. *Journal of agricultural and food chemistry*, 58(5), pp.3116–3124. Available at: https://doi.org/10.1021/jf9043327.

Mentari, A.B. Kholisoh S.N. Hidayat T.N. Hasbullah. U.A.H. 2019. Making Coffee from Kepok Banana Peel (Musa paradisiaca Linn) and it's Antioxidant Activity. *Jurnal Ilmu Pangan dan Hasil Pertanian*, 3(1), pp.94–105. Available at: http://dx.doi.org/10.26877/jiphp.v3i1.3872.

Mohapatra, D., Mishra, S Sutar, N., 2010. Banana and its by-product utilisation : an overview. *Journal of Scientific and Industrial Research*, 69(May), pp.323–329.

Mottram, D.S., 1994. Flavor Compounds Formed during the Maillard Reaction. In T. Parliment, ed. *Thermally Generated Flavors*. Washington, DC: American Chemical Society, pp. 104–126. Available at: https://doi.org/10.1021/bk-1994-0543.ch010.

Narasimman, R. Prabhakaran, K., 2012. Preparation of low density carbon foams by foaming molten sucrose using an aluminium nitrate blowing agent. *Carbon*, 50(5), pp.1999–2009. Available at: http://dx.doi.org/10.1016/j.carbon.2011.12.058.

Sidel, J.L. Stone, H., 1993. The role of sensory evaluation in the food industry. *Food Quality and Preference*, 1(1–2), pp.65–73. Available at: https://doi.org/10.1016/0950-3293(93)90314-V.

Sofa, A.D., Nurdyansyah, F. Hasbullah, U.H.A., 2019. Physical Characteristics of Analog Coffee from Kepok Banana Skin (Musa paradisiaca) Fermented with Lactobacillus plantarum. *International Journal of Advance Tropical Food*, 1(1), pp.0190101-37-0190101-41.

Tomasik, P. Jane, J., 1995. Reaction of Starch and Cellulose with Products of Thermal Decomposition of Mono- and Disaccharides. *Starch-Stärke*, 47(1), pp.24–29. Available at: https://doi.org/10.1002/star.19950470107.

Vázquez-Araújo, L., Verdú, A., Navarro, P., Martínez-Sánchez, F. and Carbonell-Barrachina, Á.A., 2009. Changes in volatile compounds and sensory quality during toasting of Spanish almonds. *International journal of food science & technology*, 44(11), pp.2225–2233. Available at: https://doi.org/10.1111/j.1365-2621.2009.02063.x.

Yanagimoto, K., Lee, K.G., Ochi, H. and Shibamoto, T., 2002. Antioxidative activity of heterocyclic compounds found in coffee volatiles produced by Maillard reaction. *Journal of agricultural and food chemistry*, 50(19), pp.5480–5484. Available at: https://doi.org/10.1021/jf025616h.

Zou, T. et al., 2019. Flavour precursor peptide from an enzymatic beef hydrolysate Maillard reaction-II : Mechanism of the synthesis of flavour compounds from a sulphur-containing peptide through a Maillard reaction. *LWT - Food Science and Technology*, 110(February), pp.8–18. Available at: https://doi.org/10.1016/j.lwt.2019.04.022.

Table 1. Pearson Correlation Values

	Color Brewing Hedonic	Aroma Brewing Hedonic	Taste Brewing Hedonic	Overall Brewing Hedonic	Color Powder Hedonic	Aroma Powder Hedonic	Dark Color Powder	Banana Aroma Powder	Caramel Aroma Powder	Coffee Aroma Powder	Dark Color Brewing	Banana Aroma Brewing	Caramel Aroma Brewing	Coffee Aroma Brewing	Bitter Taste Brewing	Sweet Taste Brewing	Astringent Taste Brewing	Sour Taste Brewing	Total Phenol	IC_{50}	Moisture Content	Ash Content
Color Brewing Hedonic	1	0.888*	0.753	0.909*	0.996**	0.978**	0.996**	-0.633	0.498	0.953**	0.987**	-0.513	0.807	0.897*	0.903*	0.071	-0.58	0.923**	0.940**	-0.63	-0.443	0.494
Aroma Brewing Hedonic	0.888*	1	0.888*	0.893*	0.853*	0.899*	0.860*	-0.226	0.14	0.955**	0.928**	-0.373	0.555	0.960**	0.951**	-0.251	-0.541	0.966**	0.722	-0.343	-0.553	0.235
Taste Brewing Hedonic	0.753	0.888*	1	0.822*	0.703	0.791	0.695	-0.033	0.23	0.882*	0.762	-0.552	0.548	0.834*	0.805	-0.182	-0.344	0.941**	0.622	-0.192	-0.17	0.447
Overall Brewing Hedonic	0.909*	0.893*	0.822*	1	0.902*	0.879*	0.874*	-0.371	0.314	0.957**	0.880*	-0.288	0.555	0.941**	0.902*	0.066	-0.5	0.910*	0.743	-0.255	-0.333	0.322
Color Powder Hedonic	0.996**	0.853*	0.703	0.902*	1	0.964**	0.997**	-0.685	0.522	0.934**	0.975**	-0.484	0.809	0.878*	0.884*	0.118	-0.574	0.891*	0.944**	-0.643	-0.437	0.491
Aroma Powder Hedonic	0.978**	0.899*	0.791	0.879*	0.964**	1	0.968**	-0.558	0.543	0.926**	0.976**	-0.609	0.783	0.852*	0.848*	0.122	-0.695	0.928**	0.938**	-0.628	-0.368	0.553
Dark Color Powder	0.996**	0.860*	0.695	0.874*	0.997**	0.968**	1	-0.689	0.51	0.927**	0.985**	-0.505	0.824*	0.871*	0.885*	0.078	-0.584	0.891*	0.952**	-0.684	-0.478	0.486
Banana Aroma Powder	-0.633	-0.226	-0.033	-0.371	-0.685	-0.558	-0.689	1	-0.715	-0.403	-0.569	0.395	-0.776	-0.304	-0.354	-0.428	0.335	-0.317	-0.781	0.844*	0.22	-0.53
Caramel Aroma Powder	0.498	0.14	0.23	0.314	0.522	0.543	0.51	-0.715	1	0.301	0.402	-0.774	0.727	0.099	0.095	0.763	-0.462	0.313	0.725	-0.677	0.397	0.919**
Coffee Aroma Powder	0.953**	0.955**	0.882*	0.957**	0.934**	0.926**	0.927**	-0.403	0.301	1	0.950**	-0.423	0.692	0.976**	0.968**	-0.115	-0.445	0.982**	0.816*	-0.415	-0.449	0.379
Dark Color Brewing	0.987**	0.928**	0.762	0.880*	0.975**	0.976**	0.985**	-0.569	0.402	0.950**	1	-0.491	0.77	0.912*	0.925**	-0.045	-0.605	0.933**	0.912*	-0.629	-0.545	0.415
Banana Aroma Brewing	-0.513	-0.373	-0.552	-0.288	-0.484	-0.609	-0.505	0.395	-0.774	-0.423	-0.491	1	-0.791	-0.231	-0.252	-0.269	0.364	-0.535	-0.706	0.687	-0.245	-0.929**
Caramel Aroma Brewing	0.807	0.555	0.548	0.555	0.809	0.783	0.824*	-0.776	0.727	0.692	0.77	-0.791	1	0.553	0.605	0.143	-0.289	0.702	0.928**	-0.874*	-0.174	0.793
Coffee Aroma Brewing	0.897*	0.960**	0.834*	0.941**	0.878*	0.852*	0.871*	-0.304	0.099	0.976**	0.912*	-0.231	0.553	1	0.992**	-0.255	-0.392	0.941**	0.701	-0.293	-0.582	0.167
Bitter Taste Brewing	0.903*	0.951**	0.805	0.902*	0.884*	0.848*	0.885*	-0.354	0.095	0.968**	0.925**	-0.252	0.605	0.992**	1	-0.313	-0.355	0.934**	0.724	-0.372	-0.643	0.171
Sweet Taste Brewing	0.071	-0.251	-0.182	0.066	0.118	0.122	0.078	-0.428	0.763	-0.115	-0.045	-0.269	0.143	-0.255	-0.313	1	-0.425	-0.151	0.247	-0.172	0.627	0.525
Astringent Taste Brewing	-0.58	-0.541	-0.344	-0.5	-0.574	-0.695	-0.584	0.335	-0.462	-0.445	-0.605	0.364	-0.289	-0.392	-0.355	-0.425	1	-0.459	-0.589	0.402	0.192	-0.292
Sour Taste Brewing	0.923**	0.966**	0.941**	0.910*	0.891*	0.928**	0.891*	-0.317	0.313	0.982**	0.933**	-0.535	0.702	0.941**	0.934**	-0.151	-0.459	1	0.806	-0.423	-0.391	0.445
Total Phenol	0.940**	0.722	0.622	0.743	0.944**	0.938**	0.952**	-0.781	0.725	0.816*	0.912*	-0.706	0.928**	0.701	0.724	0.247	-0.589	0.806	1	-0.824*	-0.279	0.705
IC_{50}	-0.63	-0.343	-0.192	-0.255	-0.643	-0.628	-0.684	0.844*	-0.677	-0.415	-0.629	0.687	-0.874*	-0.293	-0.372	-0.172	0.402	-0.423	-0.824*	1	0.297	-0.635
Moisture Content	-0.443	-0.553	-0.17	-0.333	-0.437	-0.368	-0.478	0.22	0.397	-0.449	-0.545	-0.245	-0.174	-0.582	-0.643	0.627	0.192	-0.391	-0.279	0.297	1	0.433
Ash Content	0.494	0.235	0.447	0.322	0.491	0.553	0.486	-0.53	0.919**	0.379	0.415	-0.929**	0.793	0.167	0.171	0.525	-0.292	0.445	0.705	-0.635	0.433	1

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed)

AUTHOR GUIDELINES

Term and Condition

1. Types of paper are original research or review paper that relevant to our Focus and Scope and never or in the process of being published in any national or international journal
2. Paper is written in good Indonesian or English
3. Paper must be submitted to http://journal.trunojoyo.ac.id/agrointek/index and journal template could be download here.
4. Paper should not exceed 15 printed pages (1.5 spaces) including figure(s) and table(s)

Article Structure

1. Please ensure that the e-mail address is given, up to date and available for communication by the corresponding author
2. Article structure for original research contains

   Title, The purpose of a title is to grab the attention of your readers and help them decide if your work is relevant to them. Title should be concise no more than 15 words. Indicate clearly the difference of your work with previous studies.

   Abstract, The abstract is a condensed version of an article, and contains important points ofintroduction, methods, results, and conclusions. It should reflect clearly the content of the article. There is no reference permitted in the abstract, and abbreviation preferably be avoided. Should abbreviation is used, it has to be defined in its first appearance in the abstract.

   Keywords, Keywords should contain minimum of 3 and maximum of 6 words, separated by semicolon. Keywords should be able to aid searching for the article.

   Introduction, Introduction should include sufficient background, goals of the work, and statement on the unique contribution of the article in the field. Following questions should be addressed in the introduction: Why the topic is new and important? What has been done previously? How result of the research contribute to new understanding to the field? The introduction should be concise, no more than one or two pages, and written in present tense.

   Material and methods,"This section mentions in detail material and methods used to solve the problem, or prove or disprove the hypothesis. It may contain all the terminology and the notations used, and develop the equations used for reaching a solution. It should allow a reader to replicate the work"

   Result and discussion, "This section shows the facts collected from the work to show new solution to the problem. Tables and figures should be clear and concise to illustrate the findings. Discussion explains significance of the results."

   Conclusions, "Conclusion expresses summary of findings, and provides answer to the goals of the work. Conclusion should not repeat the discussion."

Acknowledgment, Acknowledgement consists funding body, and list of people who help with language, proof reading, statistical processing, etc.
References, We suggest authors to use citation manager such as Mendeley to comply with Ecology style. References are at least 10 sources. Ratio of primary and secondary sources (definition of primary and secondary sources) should be minimum 80:20.

Journals

Adam, M., Corbeels, M., Leffelaar, P.A., Van Keulen, H., Wery, J., Ewert, F., 2012. Building crop models within different crop modelling frameworks. Agric. Syst. 113, 57–63. doi:10.1016/j.agsy.2012.07.010

Arifin, M.Z., Probowati, B.D., Hastuti, S., 2015. Applications of Queuing Theory in the Tobacco Supply. Agric. Sci. Procedia 3, 255–261.doi:10.1016/j.aaspro.2015.01.049

Books

Agrios, G., 2005. Plant Pathology, 5th ed. Academic Press, London.