JOURNAL OF SOILSCAPE AND AGRICULTURE
Volume 3, Number 2, 2025
E-ISSN: 2963-7961
Journal Homepage: http://journal.unej.ac.id/JSA

Effect of Temperature and Roasting Time on the Quality of Argopuro Robusta Coffee

Malika Bulqis[a], Ayu Puspita Arum[a*], Dyah Ayu Savitri[a] dan Hasbi Mubarak Suud[a]

[a] Agricultural Science Study Programme, Faculty of Agriculture, University of Jember, Indonesia

ARTICLE INFO

Article History:
Received: 25 - 02 - 2025
Accepted: 13 - 04 - 2025
Published: 17 - 05 - 2025

Keyword:
robusta coffee;
roasting;
coffee chemistry properties;
organoleptic test;

Corresponding Author:
name author
[a] Agricultural Science Study Programme, Faculty of Agriculture, University of Jember, Indonesia
*email: ayu.puspita@unej.ac.id

ABSTRACT

The roasting process is a process that can determine the flavor and aroma released in coffee beans which is influenced by temperature treatment, and the length of the roasting process. The purpose of this study was to determine the effect of temperature and roasting time on the quality of Robusta Argopuro coffee. The experiment was conducted using a completely randomized design (CRD) factorial pattern with the treatment of roasting temperature variations of 190 ° C, 200 ° C, 210 ° C with a time of 10 minutes, 15 minutes and 20 minutes. Then the parameters of moisture content, pH value and caffeine content were observed as well as organoleptic tests in the form of color, taste and aroma. Data results were analyzed using analysis of variance, if there were significant differences, further tests were carried out using Duncan's multiple range test at the 5% level. Temperature and roasting time had a very significant effect on caffeine content, where the lowest caffeine content was in the combination of 200°C temperature treatment with 20 minutes roasting time. Moisture content and pH value had a very significant effect on roasting time, with the lowest moisture content and pH value obtained in 20 minutes of roasting, while roasting temperature had no significant effect on moisture content and pH value, but had a very significant effect on caffeine content. Based on the organoleptic test, panelists preferred the Argopuro Robusta coffee brew at a temperature of 200°C with a roasting time of 15 minutes.

INTRODUCTION

Coffee is one of the plantation commodities that has a high economic value because it has an important role as a source of state revenue in the form of foreign exchange and supports the people's economy. Coffee is a source of income for one and a half million coffee farmers in Indonesia. the types of coffee varieties in Indonesia are more robusta coffee (Nugroho et al, 2009). Robusta coffee has a distinctive characteristic that is concentrated and slightly bitter than Arabica coffee. This is due to the higher caffeine content of robusta coffee, which is around

2.2%. The taste and aroma of robusta coffee is stronger, similar to chocolate, black tea and nuts. Robusta coffee as the main ingredient for making drinks mixed with chocolate, milk or milk cream such as cappuccino, mochaccino, caffe latte and many others that can produce flavors that are attractive to consumer tastes. In post-harvest handling and processing, coffee beans need to be considered to produce quality coffee beans (Herlina, 2022). The most important process in processing coffee beans is roasting.

The roasting process is a stage process that can determine the flavor and aroma released in coffee beans which is influenced by temperature treatment, height and length of the roasting process. According to (Islamyco et al., 2022) the temperature required to roast coffee usually ranges from 180°C to 240°C, while the time varies between 15 to 20 minutes. Treatment at 200°C with a time of 10 minutes is the best result in the roasting process. During the roasting process, the coffee beans are stirred so that the water vapor is carried out and the heat distribution is even. Roasted coffee beans are immediately removed from the machine to cool. According to (Marpaung & Lutvia, 2020) roasting that is too long will cause overroast in coffee. Therefore, proper roasting is needed to produce good quality robusra coffee. The quality of coffee beans can be seen from the roasting process carried out at the right temperature and time.

Based on the above considerations, it is necessary to conduct research on roasting argopuro robusta coffee with different temperatures and times to determine the interaction between temperature and roasting time on the quality of argopuro robusta coffee, determine the effect of roasting temperature treatment on the quality of argopuro robusta coffee, determine the effect of roasting time treatment on the quality of argopuro robusta coffee.

METHODS

Location and Time

This research was conducted at NOR Coffee Indonesia, Nogosari Village, Rambipuji District, Jember Regency, Chemistry and Food Laboratory, Faculty of Agricultural Technology, University of Jember, and Nutraceutical and Pharmaceutics UPT Integrated Laboratory and CDAST Technology Innovation Center, University of Jember. This research was conducted from December 2023 to May 2024.

Tools and Materials

The tools used in this research are NORKIT-N250 roasting machine, digital scales, tray, grinder, oven, desiccator, bottle cup, baking sheet, spatula, pH meter, beaker glass, camera and stationery. The materials used in this research are argopuro robusta coffee beans, distilled water, label paper, zipper plastic, standing pouch plastic.

Method of Collecting Data

This study used a completely randomized design (CRD) consisting of 2 factors and 3 replications. The factors used in this study are the temperature used in the roasting process and the duration of the different roasting processes. The first factor is the different roasting temperatures used consisting of 3 levels, S1: 190°C, S2: 200°C, S3: 210°C. The second factor

is the roasting time used which is different consisting of 3 levels, R1: 10 minutes, R2: 15 minutes, R3: 20 minutes.

Data Analysis

The data obtained was carried out using analysis of variance with a confidence level of 95% and if there were significant differences between treatments, further tests were carried out using Duncan's multiple range test at the 5% error level. Roasting of Robusta Argopuro coffee beans was carried out using a NORKIT-N250 roasting machine with a capacity of 250 g. Coffee beans originating from Argopuro mountainside coffee farmers who had previously gone through a semi wash process were weighed as much as 250 g for each treatment. Testing of caffeine levels in Argopuro robusta coffee using Uv-Vis spectrophotometry at a wavelength of 275 nm. The solvent value was diluted with distilled water to 100 ml and homogenized, then the absorbance obtained from the wave reading using a spectrophotometer (Rizky et al., 2023).

Testing water content using the oven method, which is by weighing an empty bottle and stabilizing it in the oven at 105ºC for 1 hour, after which it is cooled in a desiccator for 20 minutes. Robusta coffee samples as much as 3 grams that have been mashed are weighed into a bottle that has a known bottle weight. Then dried in the oven at 105ºC for 7 hours. Next, the sample was placed in a desiccator to cool for 10 minutes, then the sample was weighed. Put it back in the oven for one day, so that a constant weight is obtained. Calculation of water content as follows:

$$\text{Moisture Content } \% = \frac{B1-B2}{B1-B} x100\%$$

Description:

B = empty bottle weight

B1 = weight (sample + bottle) before drying

B2 = weight (sample + bottle) after drying (Fitriani & Yuliani, 2023)

Testing the pH value using a pH meter. Robusta coffee samples as much as 5 grams were diluted using 25 ml of distilled water using a beaker glass. Furthermore, the pH meter is turned on and dipped into the coffee solution then wait until the number appears on the pH meter (Fitriani & Yuliani, 2023). The organoleptic test was conducted to determine the panelists' assessment of the roasting results with different temperature and time treatments. The type of test carried out in the organoleptic test is the method of panelist preference in the form of an organoleptic questionnaire on the color, aroma and citrus produced from each treatment with a value of 1-6 (1 = dislike, 2 = rather dislike, 3 = normal (neutral), 4 = rather like, 5 = like, 6 = very like).

RESULTS AND DISCUSSIONS

Caffeine Content

The results of the analysis showed that the interaction between temperature and roasting time had a very significant effect on the caffeine content parameter. The average test results of

the interaction effect of temperature and roasting time on caffeine content parameters using the Duncan distance test at the 5% level are presented in Table 1.

Table 1. Results of Duncan's distance test at 5% level on the interaction effect of temperature (S) and roasting time (R) on caffeine content (%).

Temperature	Roasting Time		
	R1 (10 minutes)	R2 (15 minutes)	R3 (20 minutes)
S1 (190°C)	1,64(b)	1,66(a)	1,49(c)
	A	A	B
S2 (200°C)	1,32(a)	1,32(a)	1,3(b)
	C	C	C
S3 (210°C)	1,58(b)	1,54(c)	1,66(a)
	B	B	A

Description:

- The number followed by the same lowercase (horizontal) letter, shows the simple effect of time at the same temperature level.
- Numbers followed by the same uppercase letter (vertical) indicate the simple effect of temperature at the same time level.

It can be seen in Table 1 that the lowest caffeine content is found in the interaction of 200°C temperature treatment and 20 minutes roasting time (S2R3) which has an average value of caffeine content of 1.3% while the highest average value of caffeine content is found in the 190°C temperature treatment with 15 minutes roasting time (S1R2) and 210°C temperature treatment with 20 minutes roasting time (S3R3). From the data obtained, the value of caffeine content fluctuates, but from the results of the study it is known that the caffeine content after roasting is lower than the caffeine content before Robusta Argopuro coffee is roasted, from the initial caffeine content before coffee is roasted which is 1.68%, after roasting the caffeine content drops to 1.3% - 1.66%, based on these data, the caffeine content meets the SNI-01-3542-2004 standard with a maximum caffeine content of 2% ground coffee. The statement explained by (Virhananda et al, 2022) the longer the roasting time and the higher the roasting temperature results in lower caffeine levels in coffee. The lower the caffeine content, the lower the bitterness value in coffee. Changes in the composition of chemical reactions such as maillard reactions, pyrolysis and caramelization occur during the roasting process. According to (Setyani et al., 2018) the millard reaction that occurs during roasting causes bitterness to increase due to the release of caffeic acid and the formation of lactones and other phenol compound derivatives that affect coffee aroma and flavor. Based on the discussion above, the recommendation given to get a low caffeine content should use a combination of 200 ° C temperature treatment with a roasting time of 20 minutes (S2R3).

Moisture Content

The results of the analysis of variance of the effect of roasting time (R) showed a very significant difference to the water content paramer, so Duncan's further test was conducted using the 5% level to determine the effect of roasting time (R) on the water content parameter. The results of Duncan's further test 5% and the average effect of roasting time (R) can be presented in Figure 1.

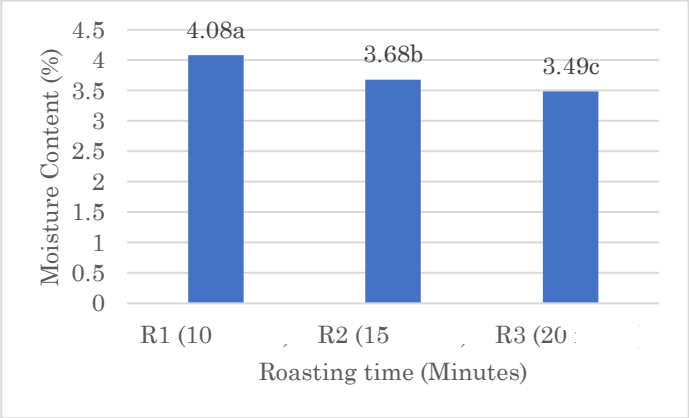

Fig.1 Duncan's further test results at the 5% level of the effect of roasting time (R) on moisture content (%) in robusta argopuro coffee beans

The results of the Duncan distance test at the 5% level of the main effect of roasting time on moisture content in the treatment of R1 (10 minutes) R2 (50 minutes) R3 (20 minutes) had a very real effect. Seen in Figure 1, the effect of roasting time on moisture content shows that treatment R3 (20 minutes) produces the lowest moisture content, this is supported by research (Rianse et al., 2024) which states that the longer roasting is used, the moisture content in the beans decreases due to the evaporation process in the beans. The moisture content of coffee powder decreases with the length of roasting time, from the initial moisture content before coffee roasting which is 11.6%, after roasting it drops to 3.49% - 4.08%, based on the observation of the length of roasting time on the moisture content of coffee powder has met the requirements of SNI 01-3542-2004, namely the maximum moisture content of coffee powder is 7%. According to (Edvan et al, 2016) on the effect of the type of roasting time on the quality of robusta coffee (Coffea robusta), the results show that the roasting time treatment affects the water content where the longer the roasting will affect the value of the water content in coffee. Based on the discussion above, the recommendations given to get low water content should use the 20-minute roasting time treatment (R3).

pH

The results of the analysis of variance of the effect of roasting time (R) showed a very significant difference on the pH value paramer, so the Duncan further test was conducted using the 5% level to determine the effect of roasting time (R) on the pH value parameter. The results of the 5% Duncan's further test and the average effect of roasting time on pH value can be

presented in Figure 2.of the 5% Duncan's further test and the average effect of roasting time on pH value can be presented in Figure 2.

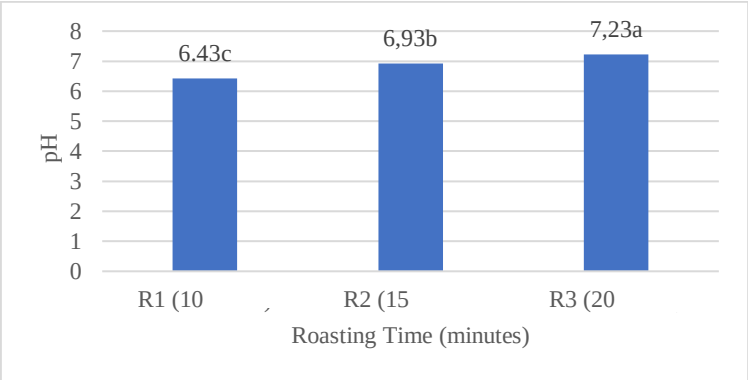

Fig. 2 Duncan's further test results at the 5% level of the effect of roasting time (R) on the pH value of robusta argopuro coffee beans

The results of the Duncan distance test at a distance of 5% show that the main effect of penyangrain length on the pH value parameter in the treatment R1 (10 minutes) R2 (50 minutes) R3 (20 minutes) has a very real effect. The pH value is very influential on the aroma and flavor of coffee. According to Nasution, 1985 in (Hutahaean, 2021) which states the process of changing the pH value during roasting occurs evaporation of water and caramelization of carbohydrates. In this study, the pH value parameter in the R3 treatment (20 minutes) produced a low acid content. The initial pH value before roasting was 6, after roasting the acidity increased to 6.43 - 7.23. Based on Figure 2, it can be seen that along with the length of roasting time, the pH value has increased. A high pH value indicates a decreased coffee acid content, while a low pH value indicates a high acid content (Fitriani & Yuliani, 2023). The decrease in pH value is due to the evaporation of several acidic substances, such as chlorogenic acid and carboxylic acid during roasting. According to (Putri, 2022), the sour taste in coffee is formed from the content of acidic compounds such as chlorogenic and carboxylic acids, so that the longer roasting chlorogenic acid easily evaporates. Based on the discussion above, the recommendations given to get low acidity should use the 20-minute roasting treatment (R3).

Organoleptic Test

Observations on the organoleptic test were carried out using 30 non-standard panelists to be asked to give a favorite value on the form that had been provided. The organoleptic test carried out is a hedonic test of argopuro robusta ground coffee in the form of color, aroma and taste using a 1-6 test scale.

Table 2. Observation results of organoleptic test conducted by 30 panelists

Treatment	Organoleptic Test			Score
	Colour	Aroma	Flavour	
S_1R_1	2,86	2,86	2,23	2,65
S_1R_2	3,23	3,46	3,16	3,28
S_1R_3	3,66	3,56	2,73	3,32
S_2R_1	3,63	2,5	3,03	3,05
S_2R_2	4,3	4,43	4,23	4,32
S_2R_3	4,56	4,06	3,46	4,03
S_3R_1	3,6	4	3,73	3,77
S_3R_2	3,43	3,63	3,63	3,56
S_3R_3	3,7	2,93	2,56	3,06

Description: 1. Dislike, 2. Somewhat dislike, 3. Neutral, 4. Somewhat like, 5. Like, and 6. Very like.

Based on table 2 shows that the organoleptic test of each treatment conducted by 30 panelists has a different score. The highest average in organoleptic testing of favorability in argopuro robusta coffee brewing is in the 200 ° C temperature treatment with a roasting time of 15 minutes giving the highest final score of 4.32 while the lowest average is in the 190 ° temperature treatment with a roasting time of 10 minutes, namely 2.65 which is not liked by the panelists. Based on the results of the study, the average value of the 1-6 scale hedonic test conducted by 30 color, aroma and taste panelists is as follows:

Color

Colour is the main parameter that becomes the level of consumer preference in a product. Colour has an important role in food commodities, namely attractiveness and identification (Loli et al., 2022). Based on the 1-6 scale hedonic test that has been carried out with different treatments, it shows that panelists like the color of coffee roasted at 200 ° C with a duration of 20 minutes, roasting in this treatment is considered to produce a coffee color that many panelists like than other treatments because it produces a blackish brown coffee color. According to (Budiman, 2021), factors that affect the color of roasted coffee besides temperature and roasting time include the formation of Maillard reactions involving carbonyl group compounds (reducing sugars) and amino groups (amino acids). The increase in reducing sugars and amino acids accelerates the occurrence of Maillard reactions that cause changes in the color of coffee to get darker. The color of the coffee that the panelists liked the least in the 190 ° C treatment with a duration of 10 minutes is because the roasted coffee is not fully cooked, so the resulting color is too bright brownish yellow.

Aroma

Based on the 1-6 scale hedonic test that has been carried out with different treatments, it shows that panelists like the aroma of coffee roasted at 200°C with a duration of 15 minutes has the highest score of 4.43, while the lowest score is in the 200°C temperature treatment for 10 minutes with a score of 2.5. Panelists did not like the aroma in this treatment because the coffee aroma that arose was not too strong on the sense of smell. The aroma of coffee that appears is caused by volatile compounds that are captured by the human sense of smell. Volatile compounds that are volatile contribute to the aroma of coffee that is smelled. The longer the roasting, the more volatile compounds evaporate so that it will affect the aroma of coffee (Tenri Fitriyah et al., 2021). According to (Purnamayanti et al., 2017) volatile compounds affect the aroma of roasted coffee formed from millard reactions or non-ezymatic browning reactions, trigonelin degradation, sugar degradation, free amino acid degradation, and phenolic compounds.

Flavour

The results of hedonic tests 1-6 that have been carried out with different treatments show that panelists like the taste of coffee roasted at 200°C for 15 minutes the most, this is because the coffee produced in this treatment produces the right coffee flavor that does not have excessive bitterness. While the lowest score from the panelist assessment was in the 190°C temperature treatment for 10 minutes. Panelists did not like the taste in this treatment because the taste of the coffee produced tended to be sour and less strong due to the very short roasted coffee beans while the temperature used was low, so that the level of roasted coffee maturity was not fully ripe (Fitriani & Yuliani, 2023).

CONCLUSIONS

Based on the results of the research that has been done, it can be concluded that the interaction between roasting temperature (190 ° C, 200 ° C and 210 ° C) and roasting time (10, 15 and 20 minutes) has a very significant effect on caffeine content. Where the lowest caffeine content is in the combination of 200 ° C temperature treatment with 20 minutes of roasting time. The treatment of roasting time (10, 15 and 20 minutes) had a very significant effect on all parameters of water content, pH value and caffeine content. From the results of organoleptic testing conducted by 30 panelists, the overall result of the panelists liked the argopuro robusta coffee brew at 200 ° C temperature treatment with a roasting time of 15 minutes.

REFERENCES

Budiyanto, B., Uker, D., & Izahar, T. (2021). Karakteristik Fisik Kualitas Biji Kopi Dan Kualitas Kopi Bubuk Sintaro 2 Dan Sintaro 3 Dengan Berbagai Tingkat Sangrai. *Jurnal Agroindustri*, *11*(1), 54–71.

Edvan, B. T., Edison, R., & Same, M. (2016). Pengaruh Suhu dan Lama Penyangraian pada Mutu Kopi Robusta (Coffea robusta). *Jurnal Agro Industri Perkebunan*, 4(1), 31–40.

Fitriani, & Yuliani, H. (2023). Karakteristik kimia kopi bubuk dan mutu densori seduhan kopi Arabika jantan (Peaberry) dengan variasi suhu penyangraian di koperasi baitul qiradh Baburrayyan. *Jurnal Pertanian Agros*, *25*(1), 212–221.

Herlina, Y. (2022). Pengaruh Suhu Dan Lamanya Penyangraian Terhadap Kualitas Biji Kopi Robusta. *Jurnal Agrica Ekstensia*. 16(2). 49-56.

Hutahaean, H. A., Farida, H. H., & Noviar, H., (2021). Sifat Fisikokimia Biji Kopi Robusta Solok Radjo dengan Lama Penyangraian Berbeda. *JOM FAPERTA, 8*(2), 1-11

Islamyco, N., Nurba, D., & Mustaqimah. (2022). Pengaruh Suhu dan Waktu Penyangraian Terhadap Warna Bubuk Kopi Arabika (The Effect Of Roating Temperature And Time On The Color Of Arabica Coffee). *Jurnal Ilmiah Mahasiswa Pertanian*, 7(1), 596–603.

Loli, Y. A., Kunarto, B., & Yulianisani, E. (2022). *Pengaruh Lama Roasting Tingkat Dark Terhadap Kadar Air , Kafein , Densitas Dan Warna Bubuk Kopi Arabika Asal Kabupaten Lembata Serta Sifat Sensori Seduhannya*. 1–11.

Marpaung, R., & Lutvia, L. (2020). Pengaruh Lama Penyangraian Yang Berbeda Terhadap Karakteristik Dan Mutu Organoleptik Seduhan Bubuk Kopi Liberika Tungkal Komposit". *Jurnal Media Pertanian*, *5*(1), 15.

Nugroho, J. W. K., Lumbanbatu, J., & Sri, R. (2009). Pengaruh Suhu dan Lama Penyangraian Terhadap Sifat Fisik-Mekanis Biji Kopi Robusta. *Seminar Nasional Dan Gelar Teknologi PERTETA*, 2081(7152), 217–225.

Purnamayanti, N. P. A., Gunadnya, I. B. P., & Arda, G. (2017). Pengaruh suhu dan lama penyangraian terhadap karakteristik fisik dan mutu sensori kopi arabika (Coffea Arabika L.). *Jurnal BETA (Biosistem Dan Teknik Pertanian*, *5*(2), 39–48.

Putri, M. K., & Dellima, B. R. E. M. (2022). Analisis Kadar Kafein dalam Green Bean dan Roasted Bean Kopi Robusta (Coffea canephora) Temanggung Menggunakan Spektrofotometer UV. *Jurnal Sains Dan Kesehatan*, *4*(6), 577–584. https://doi.org/10.25026/jsk.v4i6.1253

Rianse, M. S., Asyik, N., & Sakir. (2024). Pengaruh Suhu Dan Lama Penyangraian Terhadap Karakteristik Organoleptik Dan Sifat Fisikomia Bubuk Kopi Robusta Asal Desa Lalemba Kbupaten Muna Barat. *Jurnal Riset Pangan*, *2*(4), 62–71.

Rizky., Andri Nur. (2023). Pengaruh Temperatur Roasting Biji Kopi Terhadap Kandungan Kafein Menggunakan Spektrofotometri Uv–Vis. *Journal Storage*, 3(1), 86–95.

Surya, M. I., Normasiwi, S., Ismaini, L., & Kurniawan, V. (2020). *PENGARUH BERAT BENIH TERHADAP PERKECAMBAHAN DAN PERTUMBUHAN SEMAI BIWA (Eriobotrya japonica Lindl.)*. 79–90.

Tenri Fitriyah, A., Kape, D., & Retno Utami, R. (2021). ANALISIS MUTU ORGANOLEPTIK KOPI BUBUK ARABIKA (Coffea arabica) BITTUANG TORAJA Organoleptic Quality Analysis of Bittuang Toraja Arabica Coffee (Coffea arabica) Powder. *Jurnal Industri Hasil Perkebunan*, *16*(1), 72–82.

Virhananda, M. R. Dkk,. (2022). Analisis Kadar Asam Klorogenat Dan Kafein Berdasarkan Perbedaan Lokasi Penanaman Dan Suhu Roasting Pada Kopi Robusta (C. Canephora Pierre). *Jurnal Agroindustri Berkelanjutan*. 1(2), 245-252.

Dettenmaier, E. M., Doucette, W. J., & Bugbee, B. (2009). Chemical hydrophobicity and uptake by plant roots. *Environmental Science and Technology*, *43*(2), 324–329. https://doi.org/10.1021/es801751x/suppl_file/es801751x_si_001.pdf

Herath, H. M. S. K., Camps-Arbestain, M., & Hedley, M. (2013). Effect of biochar on soil physical properties in two contrasting soils: An Alfisol and an Andisol. *Geoderma*, *209–210*, 188–197. https://doi.org/10.1016/j.geoderma.2013.06.016

Paustian, K., Andren, O., Clarholm, M., Hansson, A. ., Johansson, G., Lagerlof, J., Lindberg, T., Petersson, R., & Sohlenius, B. (1990). Carbon and Nitrogen Budgets of Four Agro-Ecosystems With Annual and Perennial Crops, With and Without N Fertilization. *Journal of Applied Ecology*, *1*, 60–84. https://doi.org/https://doi.org/10.2307/2403568

Tan, X., Liu, Y., Zeng, G., Wang, X., Hu, X., Gu, Y., & Yang, Z. (2015). Application of biochar for the removal of pollutants from aqueous solutions. *Chemosphere*, *125*, 70–85. https://doi.org/10.1016/j.chemosphere.2014.12.058