

## Analysis of Parameter Roasting on Color and Peanuts Roasted Taste

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**Abstract** - The purpose of this study is to determine the optimum temperature of roasting, optimal rotation speed of tube and roasting time, to produce roasted peanuts with good taste and good colour. The research method is experimental using a Completely Randomized Design (CRD) with three factors of temperature, rotation and time. And analyzed using Anova method and Multiple Linear Regression. Temperature consists of five variables, namely 80°C, 85°C, 90°C, 95°C and 100°C. For rotations speed consists of 30, 35, 40 and 45 RPM. Variable of roasting time consists of four roasting times of 10, 15, 20 and 25 minutes. The numbers of data were 80 experiments. With three observation parameters namely moisture containing, color and aroma. It can be concluded that the temperature 95°C is the optimal roasting temperature; the optimal rotation speed is 40 RPM and 25 minutes for each roasting time. With the variable values mentioned, roasted bean products contain a fairly good taste, good moisture and good colour.

**Keywords:** roasting temperature, rotation speed, optimal roasting, peanut

### Introduction

Peanuts as one of the commodities of food crops have a high nutritional value and delicious taste. Peanuts can be used for food, forage and cooking oil. In addition, peanuts can be processed into roasted beans. Peanut is one of the most widely used legumes due to its nutrition and taste (Francisco and Maria, 2008). As a food, peanuts have certain compounds that are indispensable for the body's organs for survival, especially protein, carbohydrate and fat content (Susanto and Saneto, 1994). Due to their health-beneficial ingredients the consumption of nuts can contribute to a healthy diet (Schlörmann *et al.* 2015)

Roasting is a relatively fast drying process. Peanut water content will decrease from 0.5% to 5%. This reduction in water content is accompanied by the discharge of oil from the cotyledon surface. This peanut oil comes out through the cytoplasm so that the cytoplasm becomes free of oil (Indrasti, 2003). Roasting done evenly to get a uniform color of all nuts. Fatty acid compositions were not affected by roasting. Temperature problems should be well controlled, because the lower temperatures will cause raw peanut smelt. The higher temperatures will cause scorched (Indrasti, 2003).

The flavor and color of roasted peanuts have a strong impact on consumer acceptance (Lykomitros *et al.*, 2016). In order to be able to know the effect of roasting parameters on the taste and color of beans, the sensoric test should be performed. The color sensoric test was performed using a hedonic test by random sampling and given to ten panelists to be observed with a specific code. The parameters observed were roasted peanut color (Manurung, 2013). During peanut roasting, pyrazine compounds correlate highly with roasted flavor and aroma. Although roast color measurement is used to predict roasted flavor in peanuts, there are known variations between roast color and flavor development among genotypes (Baker *et al.* 2003). The control system was tested on a pilot-scale roaster and it successfully maintained roasted peanut colour within an acceptable range despite disturbances in roaster bed depth, roasting air temperature and colour setpoint (Davidson *et al.* 1999).

The results of research by Dimitrios et.al (2016) it is found that the selection of raw materials is the key factor to develop the taste, but processing method is also significantly increase the roasted color of oeanutes to darken and reduce sweetness. It also affects the color and profile of fatty acids. Chemical characteristics and fatty acid composition of the extracted oils were determined (Megahed, 2001).

The roasting process is not optimal and has not produced good quality products, due to the lack of precise roasting speed and roasting time. Roasted beans produce varying surface colors at different temperature / time combinations. Substantially, variations in chemical and physical properties will be related to the product quality (Xiaolei *et al*, 2018 and Mcdaniel, 2012). Proper roasting process is very important for the development of taste, color, and texture of the final product (Lasekan, 2014).

The roasting of peanuts was carried out using two pieces of cauldron and two stoves. During the roasting process, peanuts must be continuously stirred by a man power by using both their right and left hands. This is done because if the worker stops stirring because of exhaustion, the peanut will have burnt. This event often occurs which results in a bitter taste of the roasted beans. Such errors lead to poor quality of roasted peanut.



Figure 1 Peanuts Roasting Machine

Based on the above problems, a prototype roasting machine to help small and medium-sized enterprises to increase the productivity in roasting peanuts is introduced by reducing processing time and helping to clean the epidermis on roasted beans (Figure 1). This peanut roasting machine has been equipped with rotary reader screen, temperature controller and timer. Some grills are used including manually operated externally heated rotating drums (Olawale, 2014). Important components of this machine are the feed hopper, roasting chamber, drain outlet, main driver, speed reduction mechanism and main support and 2 Hp electric motor (Adesoji *et.al*, 2017).

Roasting was carried by using a roasting machine. The working principle of this roasting machine is as follows: first, the tube is heated and rotated with an electric motor. After the temperature of the tube is ready for roasting, the peanuts are put into the tube, then the peanuts are roasted and then the peanuts will fall into tempering.

Based on the above considerations, a research on peanut roasting using a designed roasting machine was conducted. The purpose of this study is to determine the optimal temperature, rotation speed of tube and roasting time which produced good quality of roasted peanuts in order to produce taste and color of peanuts' favoured meet with consumers' expectation.

## Materials and Methods

The materials used in this study were peanuts and liquid gas for the stove. The tools used in this study were peanut a roasting machine, a digital scale, a gas stove and a camera. The data used consists of a tube rotation speed, heating temperature and roasting time. Parameters observed were sensoric analysis related to the colour, moisture content and organoleptic preference for peanut flavor. This experiment was used a Completely Randomized Design (CRD) with three factors and analyzed using Analisis of Variance (ANOVA) and Multiple Linear Regression. The experiment was carried out with three factors of roasting temperature,

rotation speed and roasting time. Roasting temperature consists of five variables; namely 80°C, 85°C, 90°C, 95°C and 100°C. Rotation speed consists of 30, 35, 40 and 45 rotations per minute. For a roasting time consists of four types of roasting times 10, 15, 20 and 25 minutes. The amount of experimental combination consists of 80 experiments.

## Results and Discussion

### Moisture Contains Test

From the ANOVA analysis it was found that there was a significant effect of temperature, rotation, and time simultaneously on the water content which is shown in the regression model as follows:

$$Y = 96.992 - 0.136X_1 + 0.202X_2 - 0.095X_3 \quad (1)$$

Y is moisture content,  $X_1$  is roasting temperature,  $X_2$  is rotation speed and  $X_3$  is roasting time. The temperature value has a negative correlation value, meaning that the temperature increases will be followed by a decrease in the percentage value of moisture or vice versa. While the rotation value ( $X_2$ ) has a positive relationship, which means that the higher the rotation speed, will be followed by an increase in the percentage of moisture. Roasting time ( $X_3$ ) also has a negative value which means that the higher the percentage of moisture will be followed by a decrease in roasting time and vice versa. The results obtained proved that the roasting temperature and time were the main factors affecting the moisture content (Karim et al, 2011). The lower percentage of moisture content will be better for the durability of roasted beans.

From the correlation value obtained R-value of 0.924 shows that there is a very strong relationship between time, rotation and temperature to moisture content and from the value of R Square shows that the time, rotation and temperature affect 85.5% of the percentage of moisture. Figure 2 shows the effect on roasting temperature, rotation and time. It can be concluded that the lowest yield was found at a temperature of 95-100°C, rotation 30 minutes and roasting time for 25 minutes.

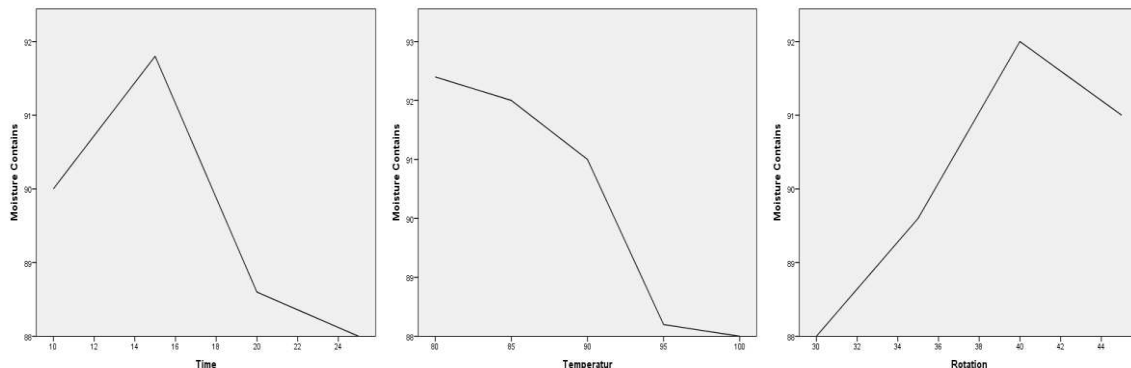


Figure 2 the Effect of Moisture Contains on Time, Temperature and Roration

### Testing of Taste

From the results of ANOVA analysis on the effect of time, tube rotation speed and roasting temperature on peanuts flavor by respondent were found to have no significant effect. Likewise, with the correlation analysis performed the R value of 0.226 shows that there is a weak relationship to the taste of nuts with time, rotation and temperature. From the results of testing the regression coefficient partially with the t distribution found that the roasting temperature and tube rotation speed have a significant effect on nut taste, but the roasting time has non-significant effect on nut taste. Descriptive sensory analyses on these same roasted nuts samples showed that optimal balance of important flavor characteristics such as roasted peanut, dark roast, and sweet had distinct roast temperature and time requirements (Smyth et al. 1998). The excessive heat increased negative flavour components such as bitter.

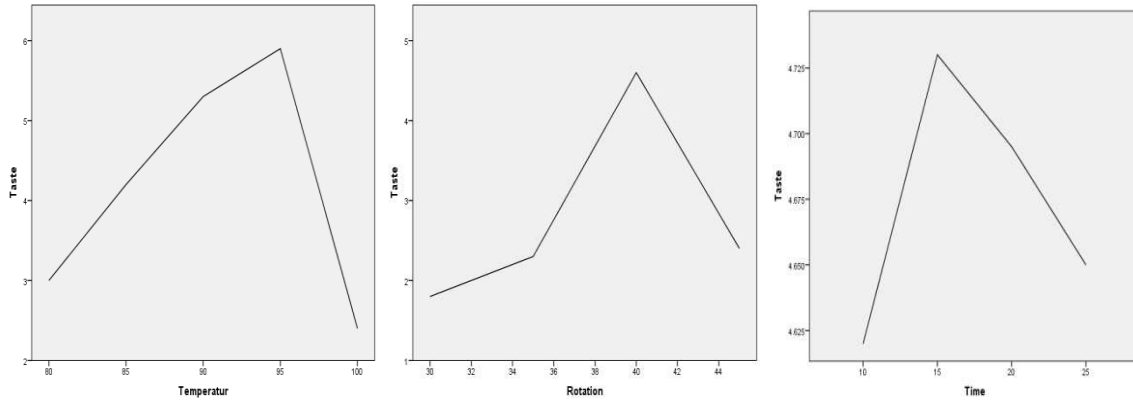


Figure 3 The Effect of Temperature, Rotation and Time on Bean Flavor

From Figure 3 it can be seen that the effect of temperature on the average flavour variation shows that at a temperature of 95°C the taste of the bean is most preferred the taste of bean are crispy and resultserred aroma. Rotation speed of 40 per minute results in the most preferred taste. 15 minutes roasting time produces the most preferred bean flavour.

### Colour Testing

From the results of ANOVA analysis on the effect of time, rotation and temperature of the roasting, the results showed that all three had a significant effect on the colour of the roasted peanut. From the results of multiple regressions analysis, it was obtained the equation:

$$Y = -4,993 + 0,074X_1 - 0,004X_2 + 0,0036X_3 \quad (3)$$

Y is the colour of the roasted peanuts,  $X_1$  is the temperature,  $X_2$  is the rotation and  $X_3$  is the time. The model above shows that the temperature and roasting time have a positive effect on the peanuts temperature. While the rotation has a negative influence on of the roasted peanuts. From the results of the correlation test it is obtained that the R-value of 0.825. It shows that there is a strong relationship to the colour of peanuts that have been roasted to temperature, rotation and time. From the R Square value shows that the time, rotation and temperature affect 68.1% of the roasted peanuts colour and and 31.9% of the peanuts colour is influenced by other factors.

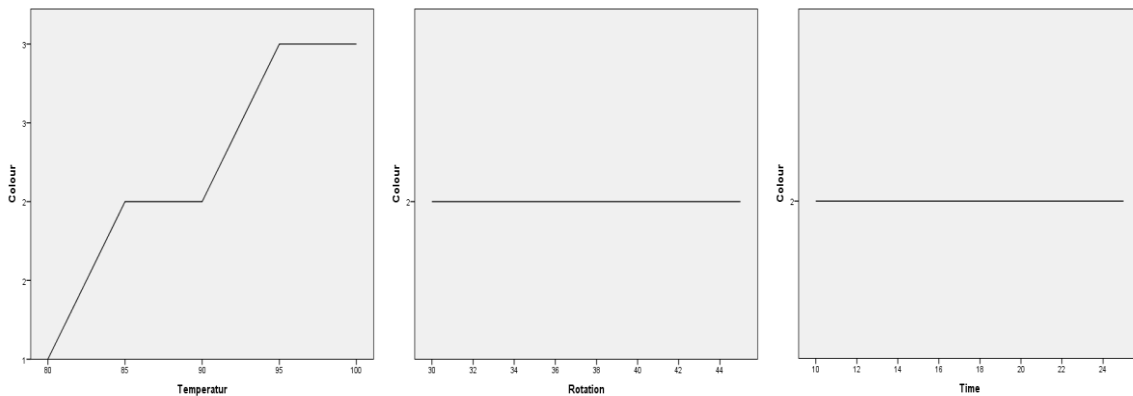


Figure 4 The Effect of Temperature, Rotation and Time on Colour of Roasted Peanuts

From the partial test results at roasting temperature, it was found that the temperature had a significant effect, the rotation had no significant effect and the roasting time partially had a significant effect on the roasted

colour. From figure 4, it can be seen that the best colours are darkish brown, which is present at roasting temperature of 95-100°C, while the time and rotation is significantly influenced by the roasted bean colour.

Table 2 Comparison of Statistical Analysis Results

Moisture content					
	Anova	Regression	Correlation	Distribution t	The best value
Temperature	significant effect	Negative	very strong	Significant effect	95°-100°C
Rotation		Positive		Non-significant effect	30 rpm
Time		Negative		Significant effect	25 minutes
Taste of Nuts					
	Anava	Regression	Correlation	Distribution t	The best value
Temperature	Non-	Positive	Poor	Significant effect	95°C
Rotation	significant effect	Positive		Significant effect	40 rpm
Time	effect	Positive		Non- Significant effect	15 minutes
Color					
	Anava	Regression	Correlation	Distribution t	The best value
Temperature	significant effect	Positive	very strong	take effect	95°-100°C
Rotation		Negative		Non- Significant effect	Non- Significant effect
Time		Positive		Significant effect	Non- Significant effect

From Table for a temperature of 95°C, it provides good moisture, colour and taste. For rotations of 40 per minute that have significant effect, from the analysis of ANOVA it has a significant and positive correlation effect. For the roasting time in Table 2, the best value is 25 minutes produce good peanut flavour. The roasting process within an appropriate temperature range and time feature improved texture, more attractive colour, as well as more favourable taste and flavor (Kita and Figiel, 2007).

## Conclusion

Temperature of 95°C is optimal rotation temperature; optimal rotation speed is 40 rpm and 25 minutes roasting period for roasting peanut. The roasted peanuts have a quite dry moisture content and resulted in a good taste and colour.

## References

- Baker, G. L., Cornell, J. A., Gorbet, D. W., O'Keefe, S. F., Sims, C. A., & Talcott, S. T. 2003. Determination of pyrazine and flavor variations in peanut genotypes during roasting. *Journal of Food Science*, 68(1), 394–400.
- Davidson, V. J., Brown, R. B., & Landman, J. J. 1999. Fuzzy control system for peanut roasting. *Journal of Food Engineering*, 41(3), 141–146.
- Francisco, M. L. D. L., & Resurreccion, A. V. A. 2008. Functional components in peanuts. *Critical Reviews in Food Science and Nutrition*, 48(8), 715–746.
- Illy, A., & Viani, R. 2005. *Espresso coffee: the science of quality*. *fstadirectcom* (p. 236). Elsevier Academic.
- Indrasti, N. S., 2003. Pedoman Pengolahan Kacang Tanah. [Http://Agribisnis.Web.Id](http://Agribisnis.Web.Id).
- Kim, S.H. and Whitt, W. 2013. The Power of Alternative Kolmogorov-Smirnov Tests Based on Transformations of the Data. *ACM Trans. Model. Comput.Simul.* V, N, Article A (January YYYY), 18 pages.
- Kita, A., & Figiel, A. 2007. Effect of roasting on properties of walnuts. *Polish Journal of Food and Nutrition Sciences*, 57(2(A)), 89–94. Retrieved from
- Lykomitros, D., Fogliano, V., & Capuano, E. 2016. Flavor of roasted peanuts (*Arachis hypogaea*) - Part I: Effect of raw material and processing technology on flavor, color and fatty acid composition of peanuts. *Food Research International*, 89, 860–869.
- Mcdaniel, K. A., White, B. L., Dean, L. L., Sanders, T. H., & Davis, J. P. (2012). Compositional and Mechanical Properties of Peanuts Roasted to Equivalent Colors using Different Time/Temperature Combinations. *Journal of Food Science*, 77(12).
- Megahed, M. G. 2001. Microwave roasting of peanuts: Effects on oil characteristics and composition. *Nahrung - Food*, 45(4), 255–257.

- Ng, S., Lasekan, O., Muhammad, K., Sulaiman, R., & Hussain, N. 2014. Effect of roasting conditions on color development and Fourier transform infrared spectroscopy (FTIR-ATR) analysis of Malaysian-grown tropical almond nuts (*Terminalia catappa* L.). *Cardiovascular Intervention and Therapeutics*, 8(1).
- Okegbile, O. J. Hassan, A.B., Mohammed, A. and Obajulu, O. 2014 Design of a Combined Groundnut Roaster and Oil Expeller Machine, *International Journal of Science and Engineering Investigations* vol. 3, issue 26.
- Olaniyan, A.M, Karimb, O. R. and Eromoselec, E. O. 2017. Design and Development a Small-scale Peanut Roaster, *The Journal of the Association of Professional Engineers of Trinidad and Tobago* Vol.45, No.2, October, pp.34-39.
- Schlörmann, W., Birringer, M., Böhm, V., Löber, K., Jahreis, G., Lorkowski, S., ... Glei, M. (2015). Influence of roasting conditions on health-related compounds in different nuts. *Food Chemistry*, 180, 77–85.
- Shakerardekani, A. Karim, R. Mohd Ghazali, H. and Chin, N. L. (2011), Effect of Roasting Conditions on Hardness, Moisture Content and Colour of Pistachio Kernels, *International Food Research Journal* 18: 723-729.
- Shi, X. Dean, L. O., .Davis, J.P., Sandeep, K.P., Sanders, T.H.. 2018, The effects of different dry roast parameters on peanut quality using an industrial belt-type roaster simulator, *Food Chemistry*, Volume 240, Pages 974-979.
- Siewsee Ng, Ola Lasekan, Muhammad, K., Sulaiman, R. and Hussain, N. (2014), Effect of roasting conditions on color development and Fourier transform infrared spectroscopy (FTIR-ATR) analysis of Malaysian-grown tropical almond nuts (*Terminalia catappa* L.), *Chemistry Central Journal* 2014, 8:55
- Smyth, D.A, Holloway, C.H., Deminf, O. E, Slade, D. M., and Levine, H. (1998). Evaluation of Analytical Methods for Optimizing Peanut Roasting for Snack Foods, *Peanut Science*, 25:70-76
- Susanto, T. and Saneto, B. 1994. *Teknologi Pengolahan Hasil Pertanian*. Bina Ilmu, Surabaya.