

EFFECT OF AIR DRYING TEMPERATURES ON THE QUALITY OF *CENTELLA ASIATICA L* DRIED PRODUCTS

Oleh :

M. Yahya

Dosen Teknik Mesin - Institut Teknologi Padang

Abstract

The objective of this study is to evaluate the effect of air drying temperature on the quality of *Centella Asiatica L*. The drying was conducted by using a constant temperature and humidity drying chamber at different drying temperatures and relative humidities (35°C, 45°C, 55°C, 65°C; 10%, 20%, 30%, 40%, 50%), respectively. Color of *Centella Asiatica L* was measured using a Chroma meter and the madecassoside and asiaticoside in *Centella Asiatica L* were identified and quantified using High Pressure Liquid Chromatography (HPLC). The results showed that the color quality of *Centella Asiatica L* for the drying temperature below 55°C was decreased but not significantly. The decreasing color quality was significant at temperature beyond 55°C and at higher relative humidity. This is caused by longer drying time to achieve equilibrium moisture content. The active ingredient (madecassoside and asiaticoside) in *Centella Asiatica L* was decreased at temperature beyond 55°C. Based on the results the quality of *Centella Asiatica L* can be preserved if the drying process was maintained at temperature less than 55°C. Also the results obtained from this study can be used to design a solar drying system for *Centella Asiatica L* and other medicinal herbs.

Keywords: Drying, *Centella Asiatica L*, Quality of the Dried Products.

1. INTRODUCTION

Centella Asiatica L belong to the family of umbrelliferae is commonly found in parts of India, Asia and The Middle East. It is also known as 'Daun Pegaga' in Malaysia, 'Luei Gong Gen' or 'Tung Chain' in China, 'Vallarai' in Tamil Nadu (India) and 'Daun Kaki Kuda' in Indonesia [1]. *Centella Asiatica L* is a traditional herbal medicine has been used in Asia for hundreds of years [2]. It contains pentacyclic triterpenes, mainly asiatic acid, asiaticoside, madecassic acid and madecassoside [3]. It is has been used for improving memory, treating mental fatigue, anxiety, and eczema [4], curing leukorrhea and toxic fever [5], antitumor [6], antiproliferative [7], antigenotoxic [8], anti-inflammatory, anticancer, antioxidation and anxiolytic [9-10].

Centella Asiatica L contains a high level of moisture content (85%-89%, wet basis) and it's highly perishable after harvesting. Therefore, its must be dried immediately to reduce the moisture content to such a level to minimize losses of the active ingredients [11-12].

In the drying process, beside removal of water the quality of dried product must be taken into consideration [13] and the quality of dried product is greatly influenced by drying conditions [14].

Conventional hot air drying method is commonly used for drying medicinal herbs or other heat sensitive biologically active products. However, medicinal herbs products are sensitive to drying temperature. The temperature may cause the quality degradation of the dried products such as loss of color, loss of active ingredient, loss of texture and shrinkage [15-17].

Based on researches undertaken by several researchers such as Doymaz and Pala [18] dried red pepper at 60°C; Demir et al. [19] dried bay leaves at 60°C; Alibas [20] dried nettle leaves at above 50°C; Arabhosseini et al. [21] dried Tarragon leaves at 60°C; Katsube et al. [22] dried mulberry leaves. They have proven that heat sensitive materials dried by using hot air dryer experience quality degradation. However, there is still lack of research to study the effect of temperature profiles on quality of *Centella Asiatica L*.

The objective of this study is to investigate the effect of different drying air temperatures and relative humidities on the quality (color and active ingredients degradation) of *Centella Asiatica* L using a constant temperature and humidity drying chamber. The results obtained from this study can be used to design a solar drying system for *Centella Asiatica* L and other medicinal herbs.

2. MATERIALS AND METHODS

2.1. Drying Procedure

Fresh *Centella Asiatica* L was bought from the local market in Kajang, Selangor, Malaysia and cleaned thoroughly before use. The initial moisture content of the *Centella Asiatica* L sample was 88% wet basis. Drying was done at four temperatures (35°C, 45°C, 55°C, and 65°C), five relative humidities (10%, 20%, 30%, 40%, and 50%) with air velocity of 1 m/s. A constant temperature and humidity drying chamber (TH-1-180-L, JEIO TECH Co., Ltd; KOREA) was used, with which the temperature and relative humidity can be controlled. The sample was suspended under a digital balance 'AND 182A' in the test section. Weight loss of the sample was measured by the digital balance and monitored on a PC connected to the balance via the RS port by using data acquisition software. The samples were dried until they reached a constant weight (equilibrium moisture content).

2.2. Quality Analysis

2.2.1. Colour

The colour of the *Centella Asiatica* L samples was measured by a Minolta Chroma meter CR-100CR colour meter (Minolta Co., Osaka, Japan) before and after drying. The color system used was the Hunter Lab system in which 'L' represents the lightness, 'a' represents the redness or greenness, and 'b' represents the yellowness or blueness. The changes in each individual color parameters were calculated as follows:

$$\Delta L = L - L_o \quad (1)$$

$$\Delta a = a - a_o \quad (2)$$

$$\Delta b = b - b_o \quad (3)$$

The subscript 'o' refers to the color reading of fresh *Centella Asiatica* L or the initial color parameters of each product at the beginning of the drying experiment.

The hue angles (h) were calculated using equation as follow:

$$h = \tan^{-1}\left(\frac{b}{a}\right) \quad (4)$$

The total color difference (ΔE) was then determined using the following equation [23]:

$$\Delta E = \left[(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2 \right]^{1/2} \quad (5)$$

2.2.2. Active Ingredients

2.2.2.1. Chemicals and Reagent

Chemical standards of made cascosside and asiaticoside for identification and quantification analysis were purchased from Guangxi Changzhou Natural Products Development Co., Ltd. (Guangxi, China). Methanol for HPLC analysis was of chromatographic grade and was purchased from Merck (Darmstadt, Germany). Water for HPLC analysis was purified by a Millipore water purification system (Millipore, Bedford, MA, USA). Other reagents were of analytical grade.

2.2.2.2. HPLC Analysis

HPLC analysis was carried out using a waters HPLC system equipped with an auto sampler and a UV/vis detector (Agilent Technologies, Germany). The column used for the analysis was a reverse-phase C₁₈ Genesis with 250 mm x 4.6 mm i.d. and 4 μ m particle diameter (Jones Chromatography, UK). The chromatographic separation was developed using a mobile phase of 0.1% phosphoric acid in water (solvent A) and acetonitrile (solvent B). Gradient conditions are 80:20 (A/B) in 30 min, 45:55 (A/B) in 5 min at flow rate of 1.4 mL/min. The injection volume was set at 20 μ l and the detection was in UV absorbance 270 nm and attenuation of 0.1 AUFS.

2.2.2.3. Sample Extraction Procedure

Extraction was carried out according to the method of Inamdar et al. [3]. For each dried *Centella Asiatica* L sample, 1g of *Centella Asiatica* L powder were extracted with with methanol-water (9:1) (2x10 ml) for 5 h at ambient temperature, followed by filtration. The filtrate was evaporated using a rotary evaporator under vacuum at 50°C to dryness to obtain a dark brown extract (0.15 g). The dried crude extract was accurately weighed (\approx 100 mg), dissolved in methanol-water (90:10) and made up to 10 ml. The solution was filtered through a 0.45 μ m filter (Waters Millipore) and the clear filtrate was used for HPLC analysis.

2.2.2.4. Identification and Quantification of Individual Active Ingredients

Identification of made cascosside and asiaticosside in extracts samples were identified by chromatography of madecascosside and asiaticosside standards and comparison of their retention times.

Quantification of individual active ingredient was carried out based on the external standard method; two standards were accurately weighed, dissolved in methanol-water (90:10, v/v) solution. The standard solutions for linear calibration were prepared by diluting the stock solution to produce a concentration sequence of 0.5, 1.5, 3, 4.5, 6 and 7.5 mg/ml. Both the stock solutions were kept at 4°C before HPLC analysis.

3. RESULTS AND DISCUSSION

3.1. Colour Analysis

Colour is one of the important qualities of dried products that influence customers' perceptions. The colour of the heat sensitive products or medicinal herbs decreased during drying [24]. The degree of colour change is dependent on drying temperature, relative humidity and drying time [25]. The effect of air temperature and humidity on the color quality of *Centella Asiatica* L are shown in Figs. 1-6.

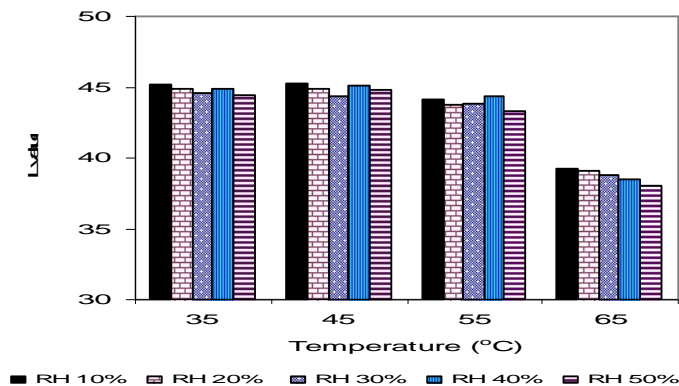


Fig.1. Lightness versus air temperature with various relative humidity

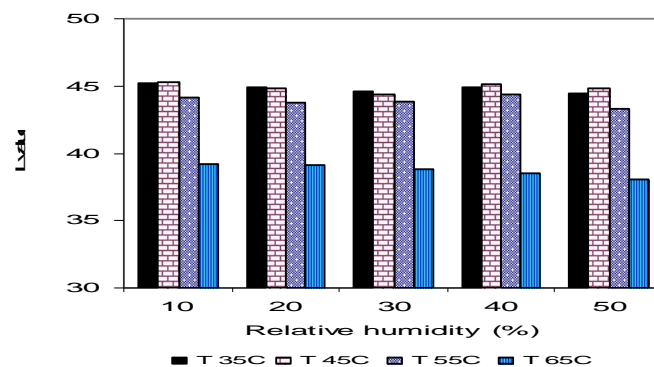


Fig.2. Lightness versus relative humidity with various air temperatures

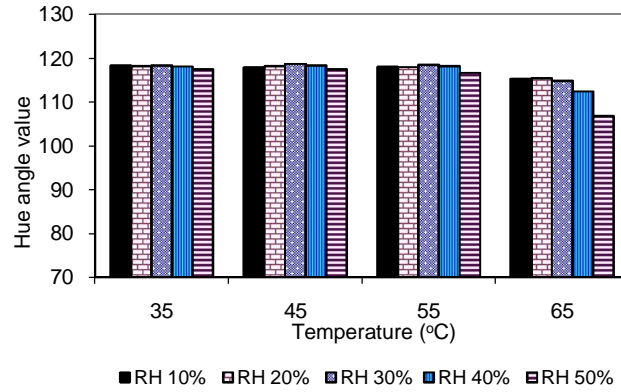


Fig.3. Hue versus air temperature with various relative humidity.

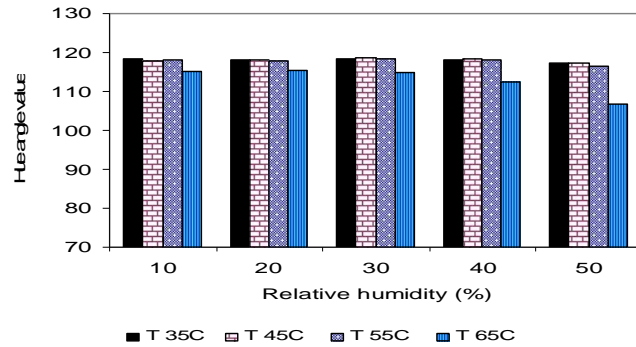


Fig.4. Hue versus relative humidity with various air temperatures.

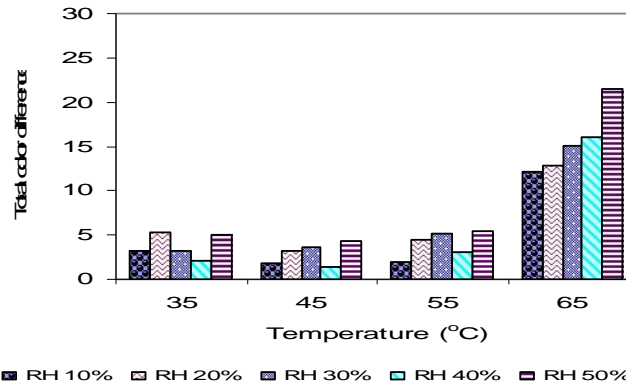


Fig.5. Total color difference versus air temperature with various relative humidity

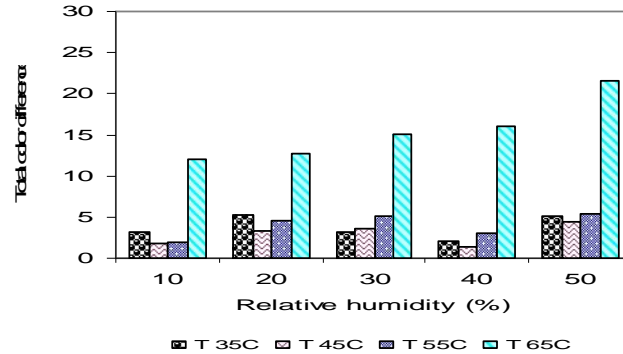


Fig.6. Total color difference versus relative humidity with various air temperatures

Figs. 1-4 show the L and hue (h) values of the dried samples at difference drying temperature and relative humidity. From the figure, it can be seen that each value of dried samples for the drying temperature below 55°C were decreased but not significantly or slightly different from the L_0 and hue (h_0) values of the fresh samples. The L and hue (h) values of the dried samples were in range of 43.28-45.26 and 118.44-117.40, respectively. Whereas the L_0 and hue (h_0) values of the fresh samples were 45.31 and 118.48, respectively. At temperature beyond 55°C, the L and hue (h) values of the dried samples were significantly decreased. The decreasing in these values is very significant at maximum relative humidity (50%) when compared with the relative humidity below 50%. This is caused by longer drying time to achieve equilibrium moisture content.

The ΔE (total color difference) values after drying are show in Figs.5-6. From the figures, it can be seen that the ΔE value of dried samples for the drying temperature below 55°C increased but not significantly. The ΔE values of the dried samples were in range 1.42-5.42. At temperature beyond 55°C, the ΔE values of the dried samples were also significantly increased. The increasing in these values is very significant at maximum relative humidity (50%) when compared with the relative humidity below 50%. These also caused by longer drying time to achieve equilibrium moisture content. The ΔE values of the dried samples were in range 12.08-21.51. Based on Figs.1-6, the color quality of dried the *Centella Asiatica* L significantly decreased or become darker at

drying temperature beyond 55°C and more significant at higher relative humidity due to high temperature and long drying time. High temperature could lead to the replacement of magnesium in the chlorophyll by hydrogen, thereby converting Chlorophylls to pheophytins [26].

3.2. Identification and Quantification of Individual Active Ingredients Analysis

The active ingredients (madecassoside and asiaticoside) in *Centella Asiatica* L were identified by comparing the retention times of madecassoside and asiaticoside standards as shown in Figs. 7-9. It could be seen that the profile of chromatograms of the madecassoside and asiaticoside in *Centella Asiatica* L, are both standards and having the same retention time. These were obtained with madecassoside and asiaticoside at 9.26 min and 11.35 min, respectively. The quantitative of individual active constituents of madecassoside and asiaticoside content in *Centella Asiatica* L was calculated using equation/correlation from respective calibration curves. The linear calibration curves were constructed by six concentration of standard solution (0.5, 1.5, 3, 4.5, 6 and 7.5 mg/ml) and repeating the experiment in triplicate. Calibration curves were constructed by plotting the integrated chromatographic peak areas (Y, mAU) versus the corresponding contents of the injected standards (X, mg/ml). Least square method regression was employed. The results expressed as the values of the correlation coefficient (R^2) were shown in the

following: $Y = 1073.2X + 37.43$ ($R^2 = 0.9999$, for madecassoside); $Y = 1149.9X + 58.85$ ($R^2 = 0.9998$, for asiaticoside), respectively. Based on the results the correlation which yielded from the linear calibration curves could be used for

the quantification evaluation of madecassoside and asiaticoside contents in *Centella Asiatica* L because of high correlation coefficients value.

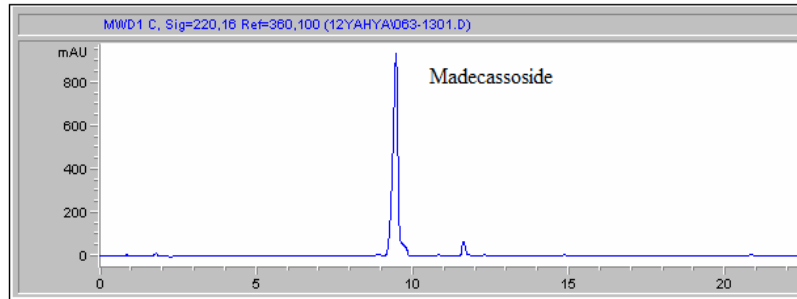


Fig.7. Typical HPLC-UV chromatogram of madecassoside standard.

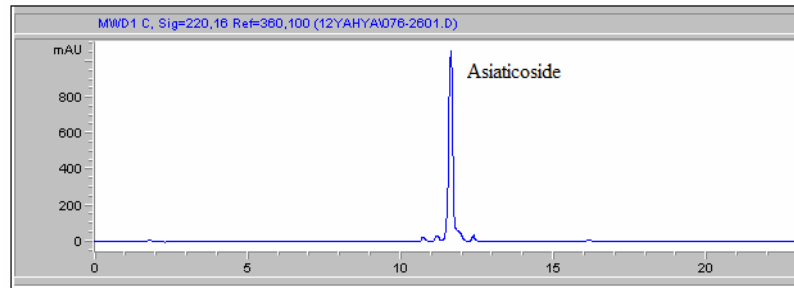


Fig.8. Typical HPLC-UV chromatogram of asiaticoside standard

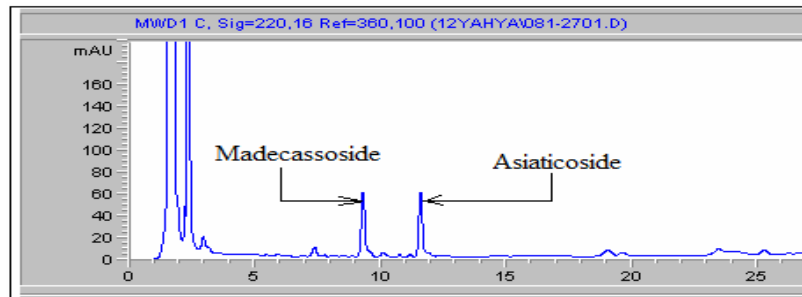


Fig.9. Typical HPLC-UV chromatograms of madecassoside and asiaticoside actual samples.

By using correlation from respective calibration curves the effect of air temperature and humidity on madecassoside and asiaticoside content in *Centella Asiatica* L were calculated and plotted as show in Figs. 10-11. From the figures it can be observed that madecassoside and

asiaticoside contents in the dried *Centella Asiatica* L decreased at drying temperature beyond 55°C and significantly at maximum relative humidity (50%) when compared with the relative humidity of 10% due to longer drying time to achieved equilibrium moisture content.

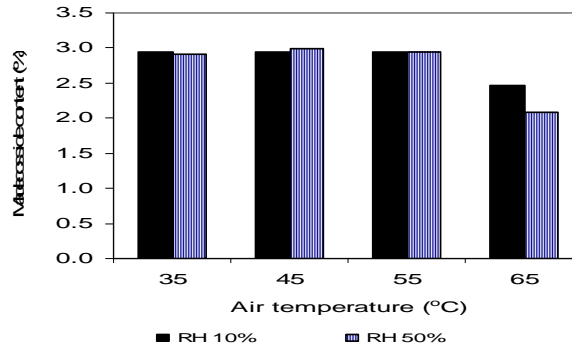


Fig.10. Madecosside content of *Centella Asiatica L* versus air temperature with various relative humidity.

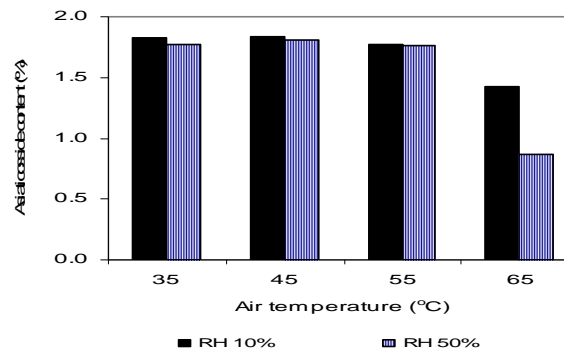


Fig.11. Asiaticoside content of *Centella Asiatica L* versus air temperature with various relative humidity.

4. CONCLUSIONS

The *Centella Asiatica L* must be dried for storage before extraction of the active component. An experimental study on the drying of *Centella Asiatica L* has been conducted by using a constant temperature and humidity drying chamber. The quality of *Centella Asiatica L* can be preserved if the drying process was maintained at temperature less than 55°C. Also the quality were significantly decreased at higher relative humidity due to longer drying time to achieve equilibrium moisture content.

5. REFERENCES

- [1] Somchit, M. N., Sulaiman, M. R., Zuraini, A., Samsuddin, L, and Somchit, N. 2004. Antinociceptive and anti-inflammatory effects of *Centella asiatica*. *Indian Journal of Pharmacology*, Volume 36, pp. 377-380.
- [2] Guangtao Jia, & Xiuyang Lu. 2008. Enrichment and purification of madecassoside and asiaticoside from *Centella asiatica* extracts with macroporous resins. *Journal of Chromatography A*, 1193 (2008) 136-141.
- [3] Inamdar, P.K., Yeole, R.D., Ghogare,A.B, and de Souza, N.J. (1996). Determination of biologically active constituents in *Centella asiatica*, *Journal of Chromatography A*, 742, pp. 127-130.
- [4] Goh, S.H., Chuah Mok, J. S. L., & Soepadmo, E. 1995. Malaysian medicinal plants for the treatment of cardiovascular diseases. Petaling Jaya: Pelanduk Publication Sdn. Bhd.
- [5] Kan, W. S. 1986. *Pharmaceutical botany*, P. 416. Taiwan: National Research Institute of Chinese Medicine.

- [6] Babu, T. D., Kuttan, G & Padikkala. J. 1985. Cytotoxic and antitumor properties of certain taxa umbelliferae with special reference to *Centella asiatica* (L) Urban. *Journal of Ethnopharmacology* 48, 53-57.
- [7] Yoshida, M., Fuchigami, M., Nago, T., Okabe, H., Matsunaga, k., Takata, J., Karube, J., Tsuchihashi, R., Kimjo, J., Mihashi, K, & Fujioka, T. 2005. Antiproliferative constituent from umbelliferae plants VII. Active triterpene and rosmarinic acid from *Centella asiatica*. *Biology and Pharmacology Bulletin* 28, 173-175.
- [8] Siddique, Y. H., Ara, G., Beg, T., Faisal, M., Ahmad, M., & Afzal, M. 2007. Protective role of *Centella asiatica* L. Extract against methyl methanesulphonate and cyclophosphamide induced genotoxic damage in cultured human lymphocytes. *Recent Progress in Medicinal Plants* 19, 369-381.
- [9] Kumar, M. H. V. & Gupta, Y. K. 2002. *J. Ethnopharmacol* 79, 253.
- [10] Gnanapragasam, A., Yogeeta, S., Subhashini, R., Ebenezar, K.K., Sathish, V. & Devaki, T. 2007. *Mol. Cell Biochem* 294, 55.
- [11] Garg, H. P, & Kumar, R. 2001. Developments in solar drying, In: *Proceeding of the Second Asian-Oceania Drying Conference (ADC 2001)*, Batu Feringhi, Pulau Pinang, Malaysia, PP. 297-319.
- [12] Janjai, S. & Tung, P. 2005. Performance of a solar dryer using hot air from roof-integrated solar collector solar collectors for drying herbs and spices. *Renewable Energy* 30: 2085-2095.
- [13] Szentmarjay, T., Pallai, E. and Szekrenyessy. 1996. Product quality and operational parameter of drying. *IDS 96*, Volume B, pp. 839-846.
- [14] Kilic, A. 2009. Low temperature and high velocity (LTHV) application in drying: Characteristics and effects on the fish quality. *Journal of Food Engineering* 91 (2009) 173-182.
- [15] Attanasio, G., Cianquanta, L, & Matteo. 2004. Effect of drying temperature on physico-chemical properties of dried and rehydrated chesnuts (*Castanea sativa*). *Food Chemistry* 88 (4):583-590.
- [16] Luagmalawat, P., Prachayawarakorn, S., Nathakaranakule, A., & Soponronnarit, S. 2008. Effect of temperature on drying characteristics and quality of cooked rice. *LWT* 41: 716-723.
- [17] Miranda, M., Maureira, H., Rodrigues, K & Galves, A. V. 2009. Influence of temperature on the drying kinetics, physicochemical properties, and antioxidant of *Aloe Vera (Aloe Barbadensis Miller)* gel. *Journal of Food Engineering* 91: 297-304.
- [18] Doymaz, I, and Pala, M. 2002. Hot-air drying characteristics of red pepper. *Journal of Food Engineering*, 55, 331-335.
- [19] Demir, V., Gunhan, T., Yagcioglu, A.K. and Degirmencioglu, A. 2004. Mathematical modelling and the determination of some quality parameters of air-dried bay leaves. *Biosystems Engineering*, 88, 325-335.
- [20] Alibas, I. 2007. Energy consumption and colour characteristics of nettle leaves during Microwave, Vacuum and Convective Drying. *Bio Systems Engineering* 96(4): 495-502.
- [21] Arabhosseini, A., Huisman, W., Bostel, A.V, and Muller, J. 2007. Long-term effects of drying conditions on the essential oil and color of tarragon leaves during storage. *Journal of Food Engineering* 79 (2007) 561-566.
- [22] Katsube, T., Tsurunaga, Y., Sugiyama, M., Furuno, T., Yamasaki, Y. 2009. Effect of air-drying temperature on antioxidant capacity and stability of polyphenolic compounds in mulberry (*Morus alba* L.) leaves. *Food Chemistry* 113 (2009) 964-969.
- [23] Nsonzi, F., & Ramaswamy, H.S. 1998. Quality evaluation of osmo convective dried blueberries. *Drying Technology: An International Journal*, 16(3-5), 705-723.
- [24] Arslan, D, and Ozcan, M.M. 2008. Evaluation of drying methods with

- respect to drying kinetics, mineral content and colour characteristics of rosemary leaves. *Energy Conversion and Management* 49 (2008) 1258-1264.
- [25] Baini, R, and Langrish, T.A.G. 2009. Assessment of colour development in dried bananas-measurements and implications for modelling. *Journal of Food Engineering* xxx (2009) xxx-xxx.
- [26] Rudra, S.G., Singh, H., Basu, S, and Shivhare, U.S. 2008. Enthalpy entropy compensation during thermal degradation of chlorophyll in and coriander puree. *Journal of Food Engineering* 86, 379-387.