

Effect of Microwave Processing and Storage on Quality of Cajuput (*Melaleuca cajuputi*) Honey from Bac Lieu-Vietnam



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Abstract

The aim of the present work was to find out if microwave processing and storage conditions can affect some of the main honey quality parameters (reducing sugar (RS), hydroxymethylfurfural (HMF), diastase number (DN), water and colour) of cajuput honey was obtained from Bac Lieu-Vietnam. RS content were analyzed by DNS method, HMF under AOAC 980.23, diastase activity based on AOAC 958.09, water content according to AOAC 969.38B and colour parameters (L*, a*, b*) were established in the CIE system. The results of the analysis showed that the physico-chemical characteristics of fresh honey was as follows: water content 23.18%, RS 717.42mg/g, HMF 4.24mg/kg, DN 4.85mg/kg, colour parameters L*a*b* 39.51-10.51-31.81. Honey was processed at continues power 30P(480 W), 50P(800 W), 70P(1120 W) for 20, 30, and 40 seconds then the honey sample was left to room temperature (20-23 °C), stored at room (<25 °C) and cool (<10 °C) temperature for eight weeks. The changes in the RS, HMF, DN, water and colour were observed. Microwave processing applied to cajuput honey did not effect on colour, while RS, HMF, DN and water content affected significantly. The storage time and temperature affected significantly on RS, DN and colour.

Keywords: Honey; Microwave processing; Storage; Reducing sugar; Hydroxymethylfurfural; diastase number; Water; Colour

Introduction

Honey is natural sweet substance produced by honey bees from the nectar of plants or from secretions of living parts of plants or excretions of plant-sucking insects on the living parts of plants which the bees collect and transform by combining it with specific substances of their own, dehydrate, store and leave in honeycombs to mature and ripen [1].

It is well known that honey as a natural product may be processed by means of heat processing for two main reasons: first of all, to destroy the micro-organisms that may contaminate it and to modify its tendency to crystallisation or delay the appearance of monosaccharide crystals [2]. During crystallisation that leads to phase separation, both liquid and non-liquid phases may coexist. Simultaneously, water activity of the remaining liquid phase begins to increase. This is the result of water release during crystallisation and subsequent decrease of carbohydrates concentration in the liquid phase. This phenomenon makes the honey suitable for the growth of microorganisms like yeasts and fungi and leads to sensory properties modifications and quality damage [3].

Microwave processing may be the solution for honey liquefaction without the loss of bioactivity. Microwaves as

an example of volumetric heating will influence the state of aggregation and due to the microwave/matter interaction may be applied for a short time. It results in reduction of quality losses in honey [4]. On the other hand it is well known that microwave processing can cause some damage to bioactive food components (especially enzymes) [5,6].

Therefore, in this work, we aimed to evaluate the effect of microwave processing and storage on the honey quality.

Material and Methods

Cajuput honey were obtained from Bac Lieu-Vietnam. Microwave processing of the honey samples (50 g) was performed without stirring in a microwave reactor operating (power level input 1600W = 32W/g = 100P) with continues power 30P (9.6W/g), 50P (16W/g), 70P (22.4W/g), for 20, 30, and 40 seconds.

After all treatments and cooling of the samples to room temperature, RS, HMF, DN, water content and colour were determined as a function of time. Beside that, honey was stored at room (<25 °C) and cool (<10 °C) temperature for eight weeks, analyzed the main honey quality. RS can be investigated by the 3,5-dinitrosalicylic acid (DNS) method employing glucose as the

standard at 540nm [7]. HMF content is based on AOAC 980.23. DN is based on AOAC 958.09. Water content is based on AOAC 969.38B. Colour parameters (L^* , a^* , b^*) were established in the CIE system using a Minolta Chroma-meter (CR-200 Series, Osaka, Japan). The data obtained in the study were analyzed statistically using analysis of variance (ANOVA) with statistically significant ($P < 0.05$).

Results and Discussion

The composition of honey depends on produced season, origin of nectar and climatic conditions [8]. The most important factor affecting honey composition is plant origin [9]. The

Table 1: Physicochemical composition of cajuput honey.

Physicochemical composition	Contents
Water (%)	23.18±0.72
RS (mg/g)	717.42±8.34
HMF (mg/kg)	4.24±0.31
DN (mg/kg)	4.85±0.24
L^*	39.51±0.14
a^*	10.51±0.06
b^*	31.81±0.23

Table 2: Effect of microwave processing on honey quality.

Processing conditions (Power-Time)	RS (mg/g)	HMF (mg/kg)	DN (mg/kg)	Water content (%)	ΔE
Before treatment	717.42a±8.34	4.24a±0.31	4.85bc±0.24	23.18a±0.72	0.00
30P-20 sec	715.04a±19.35	5.04b±0.43	4.63c±0.38	22.85a±0.88	0.07
30P-30 sec	724.54ab±4.94	5.49b±0.46	5.54ab±0.74	21.36b±0.19	0.13
30P-40 sec	759.38cd±11.88	6.44c±0.40	6.05a±0.97	21.22b±0.23	0.26
50P-20 sec	747.51bc±12.34	6.99cd±0.17	3.46d±0.15	19.88c±1.32	0.19
50P-30 sec	779.97de±9.89	7.49d±0.25	3.64d±0.24	18.67cd±0.43	0.59
50P-40 sec	816.78fg±12.59	8.13e±0.31	5.66ab±0.73	18.87cd±1.41	0.39
70P-20 sec	831.09g±16.67	8.08e±0.30	3.46d±0.06	17.64d±0.63	0.62
70P-30 sec	795.42ef±7.96	8.93f±0.31	4.63c±0.44	18.31de±0.39	0.59
70P-40 sec	777.86de±25.13	8.38ef±0.40	3.62d±0.46	16.87e±0.24	0.64

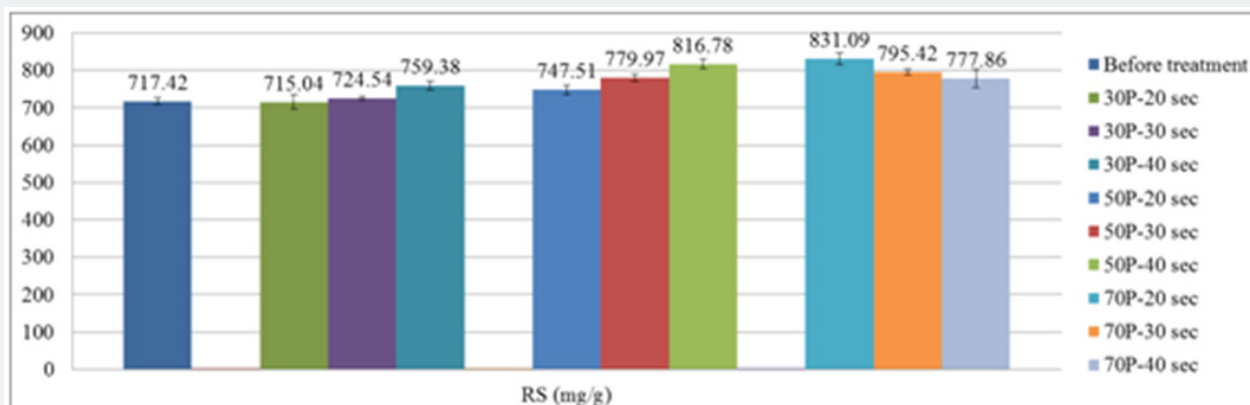


Figure 1: Effect of microwave processing on RS.

chemical components of the fresh honey sample are shown in Table 1. Water content of cajuput honey (23.18%) higher than Codex standard 12-1981 (<20%). Water content is highly important for the shelf-life of the honey during storage because a high water content causes honey to ferment and spoil [10]. RS content (717.42mg/g, >600 mg/g), HMF content (4.24mg/kg, <40mg/kg) and DN content (4.85mg/kg, ≥3mg/kg) were satisfied Codex standard. DN and HMF are considered as the main parameters for evaluating: the freshness, the heat and storage history of honey [11]. The color of honey is one of the most factors used to assess the quality of honey. The results showed that color of cajuput honey so dark ($L^* = 39.51$).

The values of RS content in different power are summarized in Table 2 & Figure 1. The changes of RS content in the honey sample according to 9 treatments had fluctuated but not significantly until 50P-30 sec (779.97mg/g). However, the RS did not less than 600 mg/g (Codex Standard 12-1981).

The initial content of HMF was low in the honey and the processing to which honey sample was increased depend on

the processing conditions. According to 9 treatments, HMF raised continuously, although according to different ratio are summarized in Table 2 & Figure 2. At 30P in 20- 40 sec, HMF from 5.04-6.44mg/kg. At 50P in 20-40 sec, HMF from 6.99-8.13mg/kg. At 70P, HMF increased 49.52% (compare with fresh honey). However, the HMF did not more than 40mg/kg (Codex Standard 12-1981).

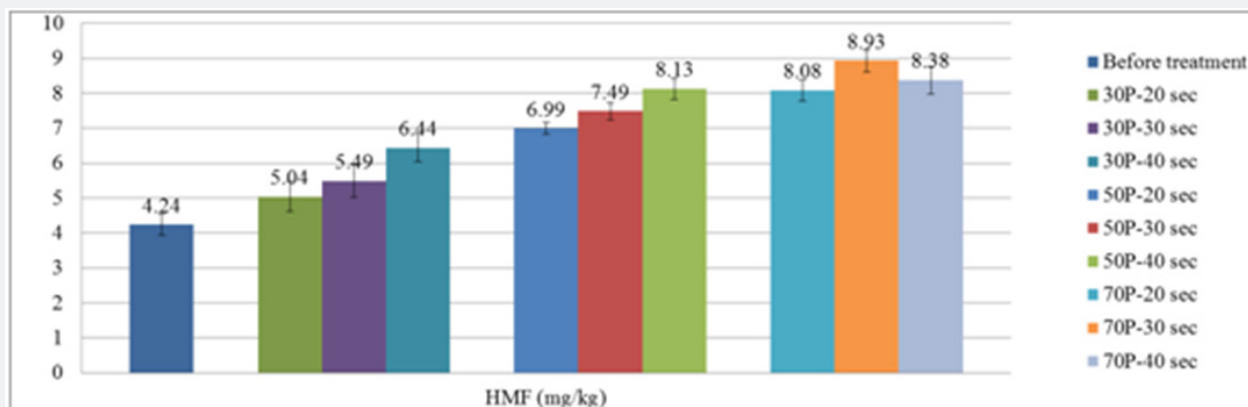


Figure 2: Effect of microwave processing on HMF.

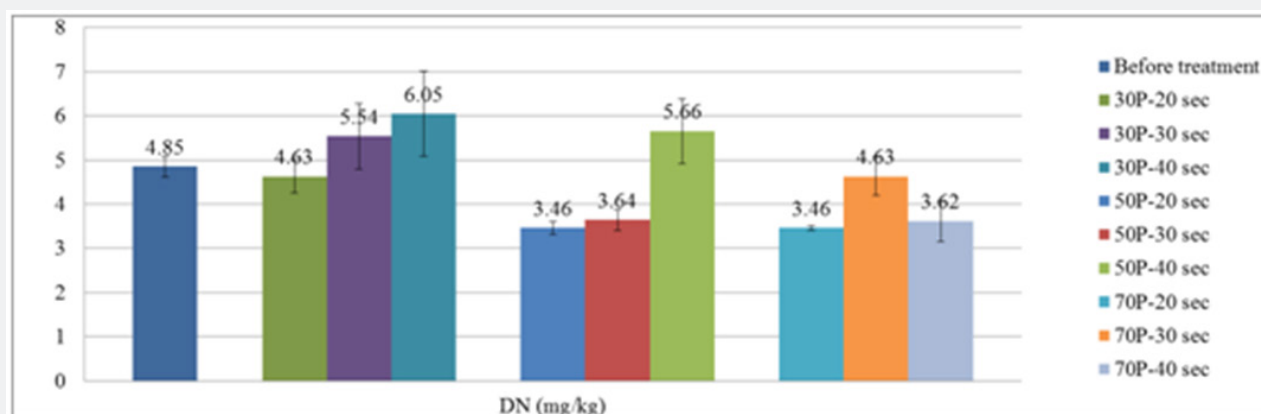


Figure 3: Effect of microwave processing on DN.

The values of DN in different power and time are summarized in Table 2 & Figure 3. DN had fluctuated according to treatments (from 4.63- 6.05mg/kg at 30P, from 3.46- 5.66 mg/kg at 50P and from 3.46-3.62mg/kg at 70P) but not less than 3mg/kg (Codex Standard 12-1981).

The results showed that as the power and time of microwave processing increased, the water content decreased. At 30P, treatment to 30 seconds to made different from the original water. When the power rises to 50P and 70P in 20 seconds, water content was significantly reduced. However, under conditions of 70P-40 seconds, the water content (16.87%) was reached to preservative conditions (17-18%).

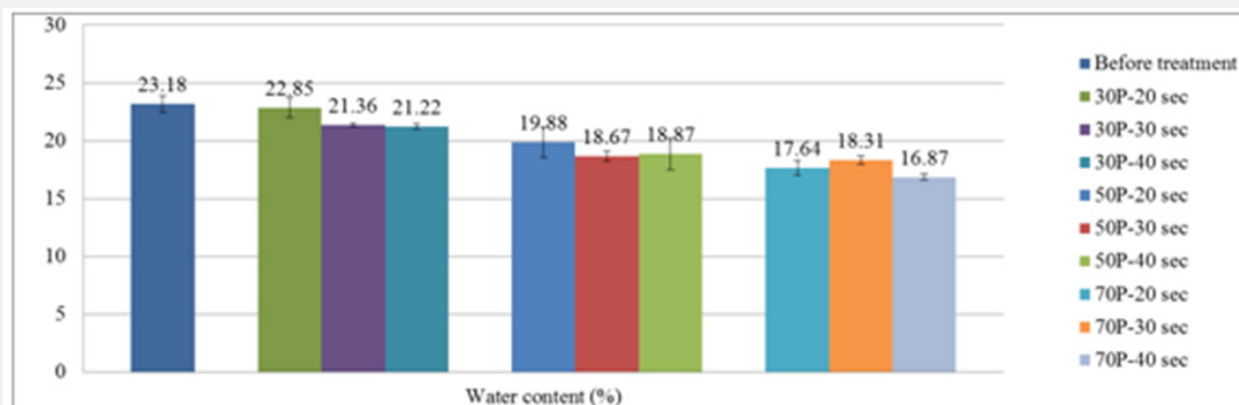
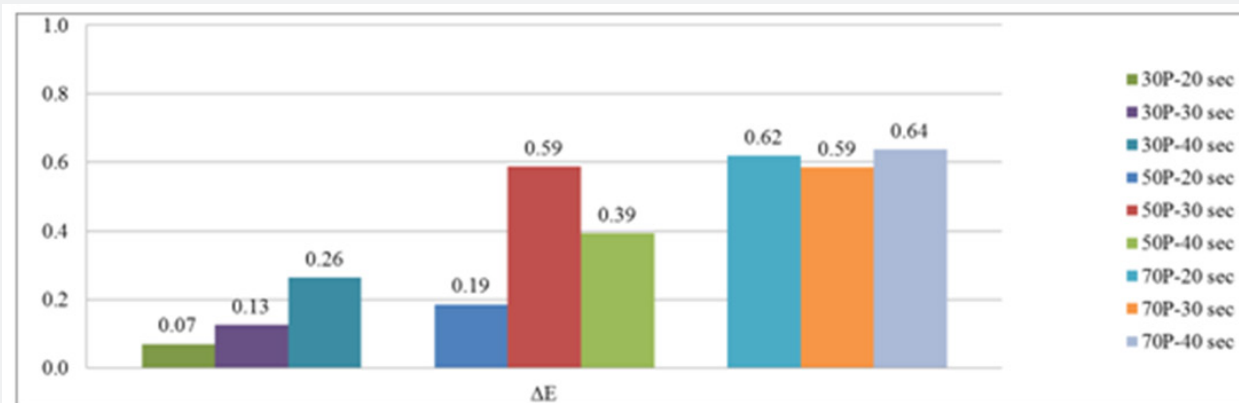
The colour of honey is one of the factors determining its price on the world market, and also its acceptability by the consumer. Light honeys are usually mild in flavor and of a higher commercial value than dark coloured honey [13,14]. According to 9 treatments, colour of honey had fluctuated but the observer does not feel the difference ($\Delta E < 1$).

After processing at 50P-30 sec, honey sample was stored at room ($<25^{\circ}\text{C}$) and cool ($<10^{\circ}\text{C}$) temperature for eight weeks. The values of RS in different storage conditions are showed in Table 3 & Figure 4-6. During the storage, there was no significant ($P < 0.05$) difference among the temperature and time on RS (from 803.72 to 819.56mg/g).

Table 3: Effect of storage on honey quality after microwave processing at 50P-30 sec.

Time (week)	Temperature (°C)	RS (mg/g)	HMF (mg/kg)	DN (mg/kg)	Water content (%)	ΔE
Before Treatment		717.42a±8.34	4.24a±0.31	4.85bc±0.24	23.18a±0.72	0.00
After Treatment		779.97b±9.89	7.49b±0.25	3.64a±0.24	18.67bc±0.43	0.59
2	25 °C	803.72bc±16.68	7.43b±0.62	5.52de±0.49	19.23b±0.96	2.08
	10 °C	810.06bc±16.17	7.58b±0.37	5.22cd±0.48	18.60bc±0.41	2.10
4	25 °C	805.30bc±29.03	7.68b±0.52	5.81e±0.43	19.60b±0.67	3.71
	10 °C	808.47bc±15.81	7.73b±0.37	5.16cd±0.21	18.92b±0.68	3.00
6	25 °C	817.18c±26.70	8.03bc±0.38	5.38cde±0.44	19.51b±0.51	5.11
	10 °C	807.68bc±23.91	7.83b±0.62	4.80bc±0.20	17.61c±0.37	3.38
8	25 °C	819.56c±11.23	8.68c±0.15	4.46b±0.34	19.13b±1.25	7.85
	10 °C	813.22c±4.94	8.13bc±0.60	4.37b±0.23	19.28b±1.01	5.50

*Values in columns with the same letter do not differ significantly at $\alpha=0.05$


Figure 4: Effect of microwave processing on water content.

Figure 5: Effect of microwave processing on colour.

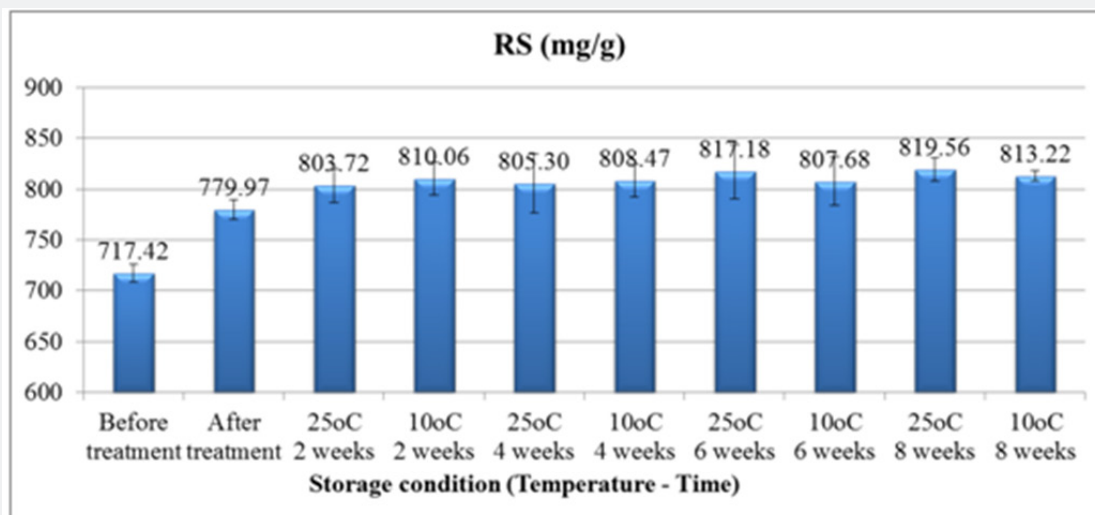


Figure 6: Effect of storage condition after microwave processing on RS.

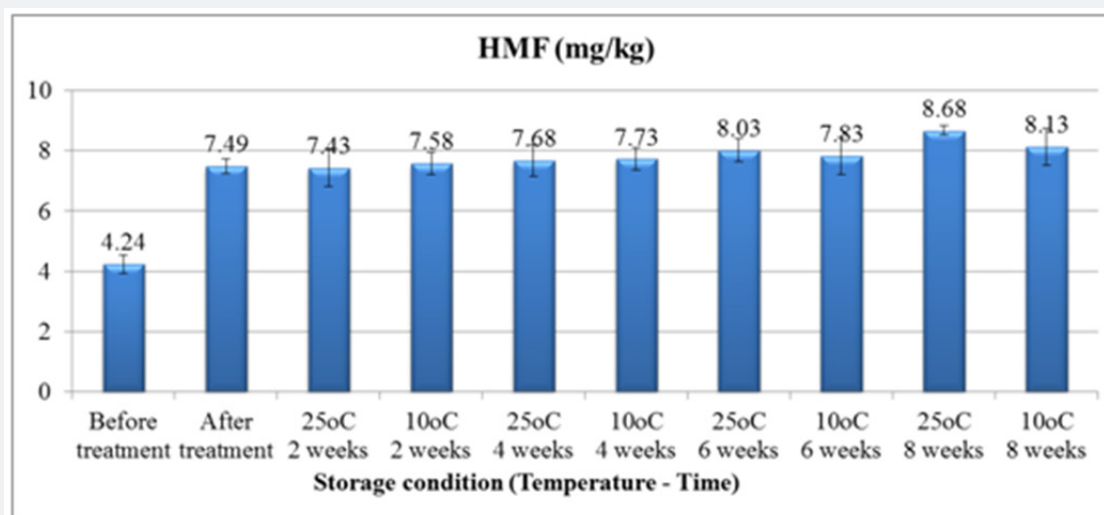


Figure 7: Effect of storage condition after microwave processing on HMF.

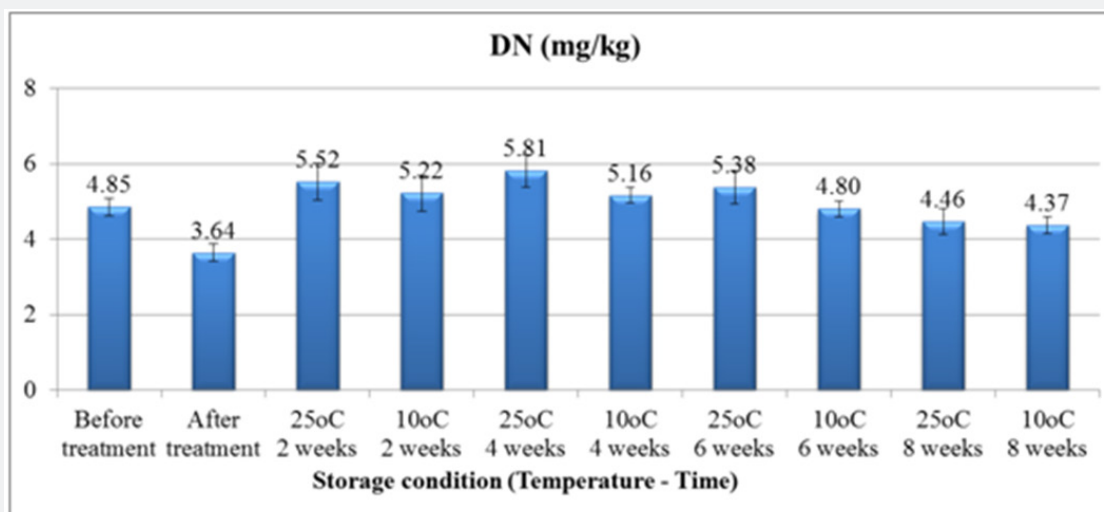


Figure 8: Effect of storage condition after microwave processing on DN.

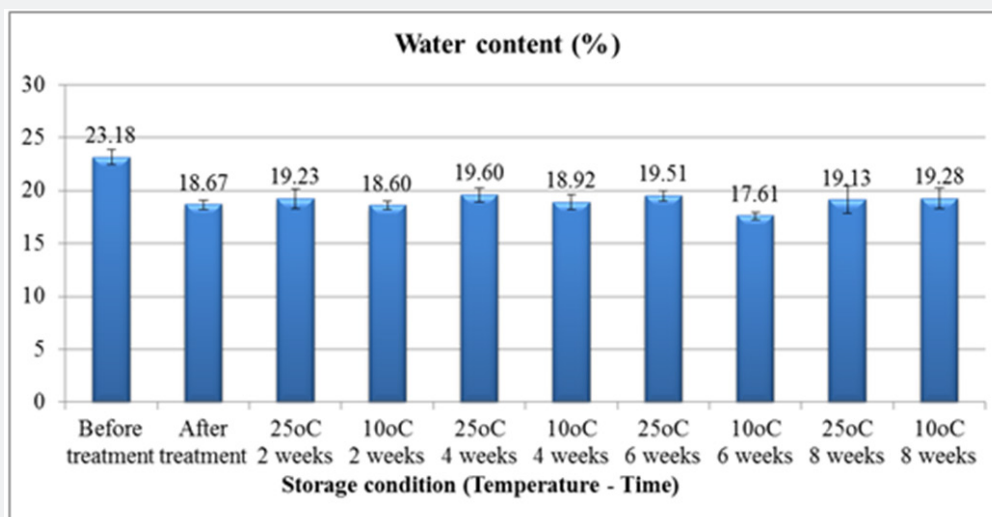


Figure 9: Effect of storage condition after microwave processing on water content.

About HMF content, according to 8 weeks in 25 °C & 10 °C, HMF had increased continuously but there was no significant ($P < 0.05$) difference (except at 8 weeks in 25 °C). However, the HMF did not more than 40mg/kg (Codex Standard 12-1981). The increase of the HMF concentration might be to the diminution of the fructose content [15], temperature and time of heating [16-18], storage conditions, use of metallic containers [19] and chemical properties of honey, which are attributed to the floral source from where the honey has been extracted (Figure 7-9). However, no information on the correlation between chemical characteristics and HMF level of honey is available [20].

A. At 25 °C, during the first 4 weeks, DN increased (5.81mg/kg). However, DN diminished (4.46mg/kg) at 8

weeks but not less than 3mg/kg (Codex Standard 12-1981).

B. At 10 °C, during the first 2 weeks, DN increased (5.22mg/kg). However, DN diminished (4.37mg/kg) at 8 weeks but not less than 3mg/kg (Codex Standard 12-1981).

C. Similar trend was noticed by White et al., (1964). Sancho et al., (1992) reported depletion in diastase number after studied the effect of storage for two years at 20 °C. Cervantes et al. [17] also reported decrease in diastase number after heating the honey at 55 °C and then storing it for three and half months at 26 °C. Castro-Vazquez et al. [18] also reported that diastase number was out of the legal limit in citrus honey stored for 12 months at 40 °C.

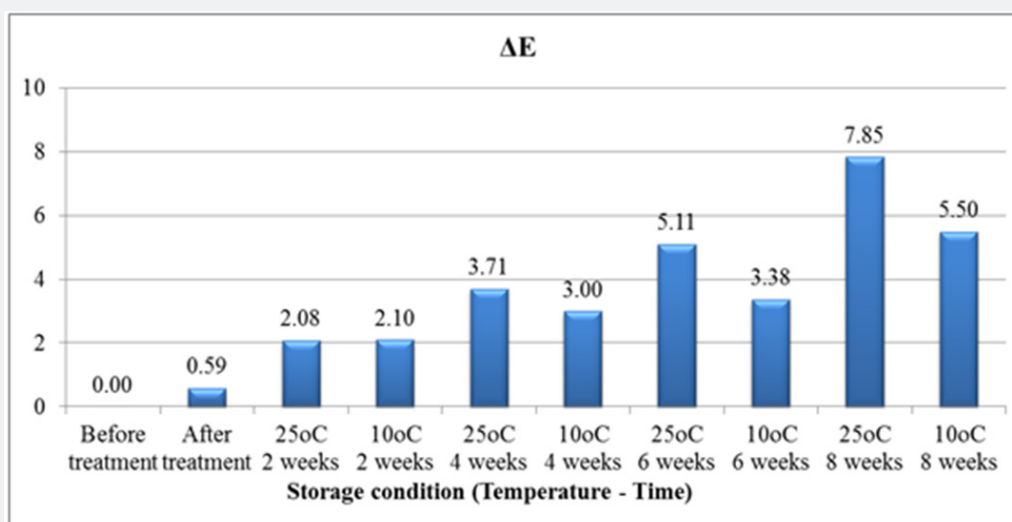


Figure 10: Effect of storage condition after microwave processing on colour.

At temperature 10 °C and 25 °C, during 8 weeks, there was no significant ($P < 0.05$) difference in water content. During 8 weeks storage, as shown in Figure 10 for the color function ΔE after an initial induction period, it followed a period of increase of color with time (2.08, 3.71, 5.11, 7.85 at 25 °C and 2.10,

3.00, 3.38, 5.50 at 10 °C). This behavior was observed in many products subjected to non-enzymatic browning. During shipping to far countries and/or dring storage, darkening of honey may occur, and parallel changes in its organoleptic properties have detrimental effects on its quality, masking its original aroma,

which promotes loss of competitiveness in the world market [20] (Figure 10).

Conclusion

The results showed that the physico-chemical characteristics of cajuput honey was as follows: water content 23.18%, RS 717.42mg/g, HMF 4.24mg/kg, DN 4.85mg/kg, colour parameters $L^*a^*b^*$ 39.51-10.51-31.81.

Microwave processing applied to cajuput honey did not effect on colour, while RS, HMF, DN and water content affected significantly but still satisfied the limits of Codex Standard 12-1981. The storage time and temperature affected significantly on RS, DN and colour ($\Delta E > 3$, large difference).

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