Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7564

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **7 (1):** 463-468 (2019)

Research Article

Effect of Microwave Treatment on Physico-Chemical Quality of Coconut Neera

Rajan Anbarasan[1], Anandakumar S.[2*], Gowri Sree V.[2] and Loganathan M.[1]

[1]Indian Institute of Food Processing Technology (IIFPT), Thanjavur

[2]Division of High Voltage Engineering, Dept. of Electrical and Electronics Engg., College of Engineering Guindy, Anna University. Chennai. 25

*Corresponding Author E-mail: anand@iifpt.edu.in

Received: 5.01.2019 | Revised: 8.02.2019 | Accepted: 14.02.2019

ABSTRACT

Coconut neera has many nutritional and medicinal values also rich in sugar content. It is highly susceptible to natural fermentation by Saccharomyces cerevisiae. Fermented neera is known as toddy which is an alcoholic beverage and produces off flavour and taste. In order to stop the fermentation, it is required to control the microbial growth in fresh neera. Among the different preservation methods microwave heat treatment has advantages of volumetric heating and higher penetration depth. Hence the present study was aimed to investigate the effect of microwave treatment at three different power levels of 520W, 720W and 900W and exposure time 3, 6 and 9 min on physico chemical parameters such as Weight loss, colour, pH, acidity, TSS, browning index, total phenolic content and reducing sugar. One way Anova was performed to identify the significant differences among the treatments. Higher power levels and exposure times significantly affect the quality of neera ($p<0.05$). All of the coconut neera samples of high power level and shorter exposure time had a low changes in the quality parameters.

Key words: *Coconut Neera, Microwave, Preservation, Physico-chemical, Fermentation and Quality.*

INTRODUCTION

In India Coconut (*Cocos nucifera*) cultivation was started before 1200 BC[14]. As per Ministry of Agriculture & Farmer Welfare report, the total area of coconut production in India's is 20, 97,000 hectares in 2017-2018. Kerala, Karnataka and Tamil Nadu are the top three coconut cultivating states in terms of area[6]. Coconut is cultivated for nutritional and medicinal values. It is used as a food in tropical countries since it contains essential micro minerals and nutrients which are important to human health[5]. Coconut sap (neera) is a healthy drink which is obtained by cutting the unopened spadix of the coconut tree. Neera collection usually happens just before sun rise[3]. The coconut sap or neera collected from cut end of inflorescence. Where the coconut sap begins to ooze out[1].

Cite this article: Rajan, A., Anandakumar, S., Gowri Sree, V., Loganathan, M., Effect of Microwave Treatment on Physico-Chemical Quality of Coconut Neera, *Int. J. Pure App. Biosci.* **7(1):** 463-468 (2019). doi: http://dx.doi.org/10.18782/2320-7051.7564

Earthen pots or sometimes were used to collect the neera from the tree. Then vessel Neera is brought down from the top of the tree. Then it will be filtered by wire mesh and stored in chilled condition[22]. Now a day's thermal insulation boxes are used to collect the coconut sap from the tree[10]. Apart from fresh neera the products obtained from neera also highly nutritive and valuable. Coconut jiggery, coconut palm sugar, coconut flower syrup are some of the product obtained from it[4]. Minerals, salts, high protein and acids like ascorbic acid, nicotinic acid & riboflavin presents in neera makes it as high nutritive drink[18]. As per coconut development board of India, it is estimated that from one hectare of land neera alone gives the return of 2.7- 8.1 lakhs earning for every three months to the farmer based on the condition of the trees[4]. Neera is a highly profitable drink for coconut formers. However, neera is highly susceptible to spontaneous fermentation particularly caused by Saccharomyces cerevisiae[17]. This high sugar content (10-15%) under goes fermentation very rapidly when the neera collection procedures are unhygienic. This initial fermentation gives alcohol (5-8%) due to sugar conversion and produces toddy[12]. If the fermentation process continues further it produces coconut vinegar as a result of acetic fermentation. Thus, leads to the formation of 4-7% acetic in the fermented product. Nutrient content, composition and quality of neera varies depend upon location, neera tapping time and duration. As fermentation rate increases an unpleasant aroma and taste will be produced. This ultimately affects the quality and that leads to the preservation issues. High fermentable nature of neera leads to unpleasant aroma and taste, which poses preservation issues. Preservation of neera by pasteurization was studied by many researcher[19,2,15]. Microwave pasteurization of liquid foods were studied by many researchers[9,8]; and[11]. Penetration depth and higher heating rate of microwave treatment are the important factors to adapt this technology for food preservation[23]. Some of the advantages of microwave treatment are, it is direct heating and reduces heat dissipation to the environment. It provides immediate heating and improved temperature control[16]. Hence, this research is focuses on microwave heating of coconut neera to reduce the microbial load and evaluate the characteristics neera due to thermal treatments.

MATERIAL AND METHODS

2.1 Neera collection

Coconut neera sample was collected in daily basis in the morning and evening (before sunrise and after sunset) at Indian Institute of Food Processing Technology, Thanjavur. After cutting the spadix end of coconut inflorescence a High Density Poly Ethylene (HDPE 51µm) cover was tied on it to collect the neera. During the collection the HDPE cover was kept in a thermal insulated box maintained a chilling effect (3±1^{o}C) to preserve the nutritive value and reduce the microbial load of neera.

2.2 Microwave treatment

A microwave oven (Model: IFB-25BC4) with the power output of 900W was used to treat the freshly collected neera sample at different power levels such as 540W, 720W and 900W with different time intervals 3, 6 and 9 minutes. All the treatments were indicated with symbols T_1, T_2, T_3, S_1, S_2, S_3, B_1, B_2, B_3 were alphabets T, S and B represents power levels 540W, 720W and 900W and subscript 1, 2 and 3 indicates treatment times 3, 6 and 9 minutes respectively. Fresh neera was kept as control which was denoted here as C. At the end of each treatment, temperature of the sample was measured using an IR temperature sensor (Model: TESTO 868). The treatments were performed in triplicates namely R_1, R_2, R_3 and the average values were taken for analysis.

2.3 Physico-chemical properties

Weight loss, Colour, pH and TSS of fresh neera and microwave treated neera values were measured directly by Hunter colour meter (Model: Colour Quest XE, USA), pH meter (INFRA DIGI – digital micro controller pH meter) and refractometer (ATAGO Model-PAL 1, range 0~53^{o}B) respectively as per standard procedure. For each microwave

treatment 150ml of fresh neera was taken. The water loss was observed at different microwave power levels and exposure time of neera. The initial and final volume was measured in order to calculate the water loss in percentage.

$$Water\ loss = \frac{Initial\ volume - Final\ volume}{Initial\ volume} \times 100 \qquad (2.1)$$

Total colour change was calculated by the following Equation (2.1) and it was denoted by ΔE^{24}.

$$\Delta E = \sqrt[2]{(L^* - L^*_i)^2 + (a^* - a^*_i)^2 + (b^* - b^*_i)^2} \qquad (2.2)$$

Where,

L^*, a^*, b^* are the colour values of neera at initial time.

L^*_i, a^*_i, b^*_i are the colour values of neera at time

Browning index was measured by the difference between the absorbance of sample at 420nm and 700nm with respect to distilled water[21] and turbidity was measured at the absorbance value of 610nm[13] by UV spectrophotometer (Thermo scientific-Evolution 201).

Acidity was determined by titration method using 0.1N NaOH with phenolphthalein as indicator and expressed as citric acid equivalent (g Citric acid/lit). Total phenol content was measured by spectrometric method. Test sample (200 µl) was mixed with 9.8ml of distilled water, 2.5 ml of 10 fold diluted *Folin- Ciocalteu's* reagent and 2.0 ml of 7.5% Na_2CO_3. Then it was incubated at room temperature for 30 minutes. Finally, absorbance was determined at 760 nm. The total phenol concentration was calculated from the Gallic acid (50–500µl/ml) standard curve equation and the results were expressed in mg Gallic acid equivalents per ml sample (mg GAE/ml). Similar test was carried out for all the samples. For reducing sugar modified DNS method of Marisa Garriga *et al*.[7] was used. 0.25 milliliter of neera was mixed with 0.25 milliliter of DNSA colour reagent then diluted by 3.5 milliliter of distilled water and boiled in water bath for 20 minutes as per previously mentioned method to get the absorbance value at 540nm. From the standard curve reducing sugar content was found in mg of glucose in 1 ml of sample[7].

2.4 Statistical Analysis

Statistical analysis was performed at five per cent confidence to analyze the significance of the treatments. When $P \leq 0.05$ the null hypothesis was rejected. So, there was significant difference between the treatments. If the $P > 0.05$, then there was no significant difference between the treatments.

RESULTS AND DISCUSSION

The results on effect of microwave treatments on the physical and biochemical characteristics of coconut neera is given in the following heading.

3.1 Effect of microwave treatment on physical parameters of neera

The effect of microwave treatment on physical parameter of coconut neera is shown in Fig. 3.1. from the figure it is observed that the colour (ΔE) values are varying from 2.061 to 3.89. Among the treatments the changes in the colour value was observed less in T1, S1 and B1 treatment samples and found high in T3, S3 and B3. This changes are due to higher power levels and exposure time of treatments. Similarly, the browning index and weight loss was increasing with increasing the power levels and exposure time. The minimum and maximum browning index and weight loss were observed as 0.215 and 0.539; 2.44 and 59.56 per cent respectively. Among the treatments the browning index and weight loss was found less in T1 followed by S1 and B1

were 0.27, 0.30 and 0.368; 2.44, 5.78 and 12.44 per cent respectively. The changes were observed more in T3, S3 and B3 Treatments. The browning index value of control sample observed as 0.215.

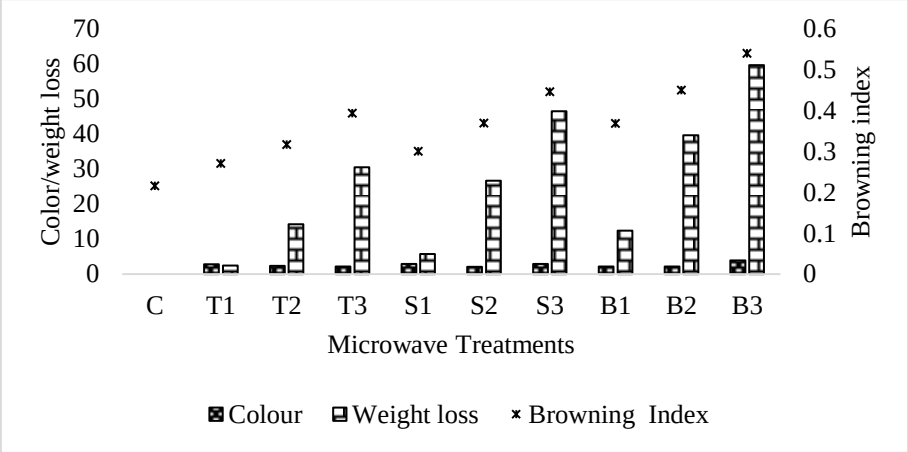

Fig. 3.1 Effect of Microwave Treatment on Physical Parameters of Coconut Neera

3.2 Effect of microwave treatment on biochemical parameters of neera

Microwave heating resulted in changes in the biochemical parameters of coconut neera are given in Table 3.1. From the study it is observed that the significant differences with the treatments in pH values. The pH of fresh neera sample was found as 6.09 and the values got decreased during the microwave treatment at different power levels and exposure time. Among the treatments the changes were found less in T1, S1 and B1were observed as 5.57, 5.73 and 5.70 respectively. Also the acidity values are increased with increasing the power levels and exposure times. The acidity of fresh neera was found as 0.38 and the highest acidity value was found in B3 treatment (900W, 9min) as 0.64 (g citric acid/liter). The decreasing trend in pH shows that there was an increase in acidity. So, concentration of acid present in neera increased as the weight loss increases. Similar result was found when apple juice was pasteurized[21] and osmotic evaporation of camu–camu juice[20]. Similarly, it was found that the TSS of the coconut neera was increasing with increasing the power levels and time periods. Among the treatments the TSS was found high in T3, S3 and B3 were found as 24.10, 31.93 and 42.20^{o}B respectively. The control sample TSS was found as 16.87 ^{o}B.

Table 3.1: Effect of Microwave treatment on Biochemical Parameters of Coconut Neera

Microwave Treatments	Power, W	Exposure time, min	TSS, ^{o}B	pH	Acidity (%)	Turbidity
T1	540	3	17.37±0.46	5.57±0.34	0.49±0.05	0.395±0.114
T2		6	19.32±1.12	5.74±0.44	0.41±0.09	0.470±0.081
T3		9	24.10±1.23	5.85±0.46	0.45±0.05	0.562±0.055
S1	720	3	19.03±0.21	5.73±0.49	0.45±0.14	0.445±0.119
S2		6	22.90±0.66	5.67±0.52	0.49±0.09	0.607±0.118
S3		9	31.93±1.81	5.41±0.45	0.64±0.05	0.780±0.049
B1	900	3	20.00±0.30	5.71±0.43	0.47±0.09	0.457±0.027
B2		6	27.73±0.76	5.55±0.44	0.53±0.09	0.753±0.115
B3		9	42.20±1.25	5.43±0.42	0.64±0.05	0.928±0.075
Control (C)			16.87±0.80	6.09±0.67	0.38±0.05	0.332±0.077

The reducing sugar and total phenolic content values with the effect of microwave treatment is given in Fig. 3.2. From the figure it is observed that the values were increasing as power level and exposure time increases. Both reducing sugar and total phenolic content were

found to be high at 900W power level and 9 min exposure time and recorded as 20.26±1.78 mg Glucose/ml and 0.620±0.095 mg Gallic acid/ml respectively. The initial reducing sugar and total phenolic content values were found as 12.02±0.25 mg Glucose/ml and 0.202±0.038 mg Gallic acid/ml respectively.

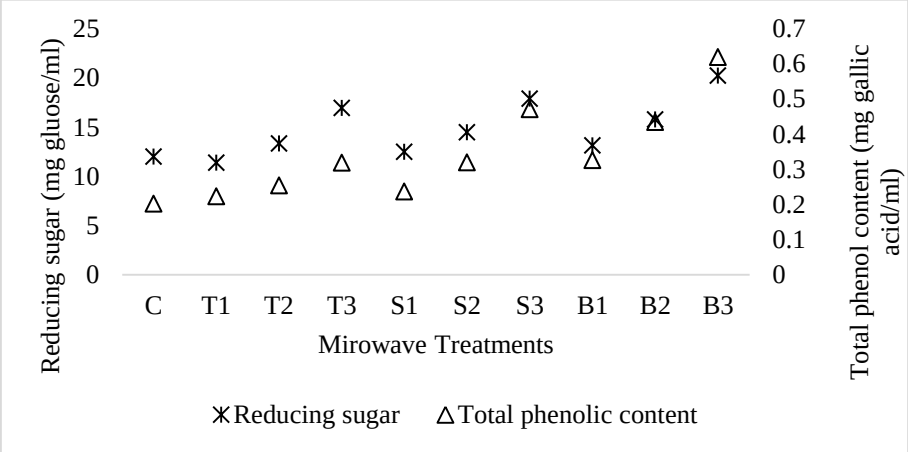

Fig. 3.2 Effect of Microwave on Reducing sugar and Total phenolic content of Neera

CONCLUSIONS

Results from this study its clearly shows that the microwave treatment affected the physico chemical qualities of coconut neera compared with fresh sample. Also from the statistical analysis it is observed that the differences were found ($p<0.05$) between control and other treatments. The quality changes were observed more in high power level treatment at 900W and exposure time 9 min compared with 540W and 720W. Coconut neera is heat sensitive product hence controlling the temperature and treatment time or high temperature short time process retains the physico chemical parameters.

REFERENCES

1. Atputharajah, J., Widanapathirana, S., & Samarajeewa, U., Microbiology and biochemistry of natural fermentation of coconut palm sap. *Food Microbiology*, **3(4):** 273-280 (1986).
2. Baliga, B., & Ivy, A., Beverage preservation, pasteurization of palm sap (Neera). *Journal of Agricultural and Food Chemistry*, **9(2):** 149-151 (1961).
3. Borse, B. B., Rao, L. J. M., Ramalakshmi, K., & Raghavan, B., Chemical composition of volatiles from coconut sap (neera) and effect of processing. *Food chemistry*, **101(3):** 877-880 (2007).
4. Coconut Development Board. coconut products. Retrieved from http://coconutboard.nic.in/CoconutProducts.aspx#Neera (2019).
5. DebMandal, M., & Mandal, S., Coconut (Cocos nucifera L.: Arecaceae): in health promotion and disease prevention. *Asian Pacific Journal of Tropical Medicine*, **4(3):** 241-247 (2011).
6. Department of Agriculture Cooperation & Farmer Welfare. Area and production of horticulture crops for 2017 - 18 (Final). Retrieved from http://agricoop.gov.in/statistics/state-level (2019).
7. Garriga, M., Almaraz, M., & Marchiaro, A., Determination of reducing sugars in extracts of Undaria pinnatifida (harvey) algae by UV-visible spectrophotometry (DNS method). *Desarrollo e Innovación en Ingeniería*, 444 (2017).
8. Gentry, T., & Roberts, J., Design and evaluation of a continuous flow microwave pasteurization system for apple cider. *LWT-Food Science and Technology*, **38(3):** 227-238 (2005).
9. Hamid, M., Boulanger, R., Tong, S., Gallop, R., & Pereira, R., Microwave

pasteurization of raw milk. *Journal of Microwave Power*, **4(4):** 272-275 (1969).

10. Hebbar, K., Pandiselvam, R., Manikantan, M., Arivalagan, M., Beegum, S., & Chowdappa, P., Palm Sap—Quality Profiles, Fermentation Chemistry, and Preservation Methods. *Sugar Tech*, 1-14 (2018).
11. Heddleson, R. A., & Doores, S., Factors affecting microwave heating of foods and microwave induced destruction of foodborne pathogens–a review. *Journal of Food Protection*, **57(11):** 1025-1037 (1994).
12. Iwuoha, C. I., & Eke, O. S., Nigerian indigenous fermented foods: their traditional process operation, inherent problems, improvements and current status. *Food Research International*, **29(5-6):** 527-540 (1996).
13. Jackson, J. C., Gordon, A., Wizzard, G., McCook, K., & Rolle, R., Changes in chemical composition of coconut (Cocos nucifera) water during maturation of the fruit. *Journal of the Science of Food and Agriculture*, **84(9):** 1049-1052 (2004).
14. Menon, K. P. V., & Pandalai, K. M., The coconut palm. A monograph. *The coconut palm. A monograph* (1958).
15. Naknean, P., Improvement in Shelf Life and Safety of Pasteurized Palm Sap (B orassus flabellifer L inn.) by the Addition of Nisin. *Journal of Food Safety*, **33(4):** 515-525 (2013).
16. Nikdel, S., Chen, C. S., Parish, M. E., MacKellar, D. G., & Friedrich, L. M., Pasteurization of citrus juice with microwave energy in a continuous-flow unit. *Journal of agricultural and food chemistry*, **41(11):** 2116-2119 (1993).
17. Okafor, N., Microbiology of Nigerian palm wine with particular reference to bacteria. *Journal of applied bacteriology*, **38(2):** 81-88 (1975).
18. Phadke, S., Shrivastava, B., & Mishra, N. D. A., COMPARATIVE STUDY OF NATURAL LIQUID NEERA (BORASSUS FLABELLIFIER 'BF') WITH SUCROSE AT DIFFERENT CONCENTRATION. *Journal of Environmental Research And Development* **5(3):** (2010).
19. Ramaswamy, P., & Ramaswamy, L., Organoleptic Acceptability, Selected Nutrient Content and Physicochemical Characteristics of Coconut Neera on Storage. *Journal of Food Science and Engineering*, **7:** 192-201 (2017).
20. Rodrigues, R. B., Menezes, H. C., Cabral, L., Dornier, M., Rios, G. M., & Reynes, M., Evaluation of reverse osmosis and osmotic evaporation to concentrate camu–camu juice (Myrciaria dubia). *Journal of food engineering*, **63(1):** 97-102 (2004).
21. Schilling, S., Schmid, S., Jäger, H., Ludwig, M., Dietrich, H., Toepfl, S., Carle, R., Comparative study of pulsed electric field and thermal processing of apple juice with particular consideration of juice quality and enzyme deactivation. *Journal of Agricultural and Food Chemistry*, **56(12):** 4545-4554 (2008).
22. Swamy, G. S., Coconut Neera production and processing in Karnataka. *Indian Coconut Journal* (2013).
23. Tajchakavit, S., Ramaswamy, H., & Fustier, P., Enhanced destruction of spoilage microorganisms in apple juice during continuous flow microwave heating. *Food Research International*, **31(10):** 713-722 (1998).
24. Victor, I., & Orsat, V., Colour changes during the processing of Arenga pinnata (palm) sap into sugar. *Journal of food science and technology*, **55(9):** 3845-3849 (2018).