

Variation of antioxidant and phenolic compounds with fermentation of *Morinda citrifolia* fruit juice

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ABSTRACT

Antioxidant capacity (AC) and total phenolic content (TPC) are two major areas of studies on noni juice due to their correlation with therapeutic value. In this study, the variation of antioxidant capacity using DPPH scavenging activity and the number of phenolic compounds in noni juice using Folin-Ciocalteu reagent assay with the fermentation time and optimum process conditions for fermentation of noni juice were studied. Results show that AC is maximum around the second fermentation week, while TPC is maximum around the first fermentation week, and fresh juice has less AC and more TPC than fermented juice.

Keywords: Noni juice; antioxidant capacity; total phenolic content

INTRODUCTION

Morinda citrifolia L. which is commercially known as “noni” juice has been identified to have significant therapeutic values to prevent and cure many diseases. More than 150 bio-active compounds have been identified and many of them are phenolic compounds, organic acids or alkaloids. (Carrillo-López & Yahia, 2011). Antioxidants and phenolic compounds can contribute to free radical scavenging activity to prevent oxidation in cells.

AC of noni juice can be determined by DPPH assay while TPC can be determined by Folin–Ciocalteu assay. (Yang et al., 2010). Precise studies are necessary to specify the variance of AC and TPC under different fermentation periods and process conditions.

METHODOLOGY

- Measurement of AC and TPC with fermentation time

After cleaning of noni fruits with distilled water, they were allowed to ripen by 3-4 days. Then, they were placed inside the food-grade, plastic, air-tight reactor which had a separator with a stainless-steel strainer, IV set, and an airlock.

For the determination of AC, juice

samples were diluted with distilled water at various ratios. Then 100 µl diluted noni juice was added to 4 ml of a solution of 0.025 g/L DPPH in methanol. DPPH solutions were prepared for each assay separately. After 30 minutes, the absorbance of noni juice- DPPH solution was measured at 517 nm with the UV-1800 Spectrophotometer. Remaining DPPH concentrations were calculated from the experimentally derived DPPH standard curve. Then, the remaining DPPH percentages were calculated by, (Krishnaiah, Sarbatly, & Nithyanandam, 2011)

$$DPPH_{rem} = \left(\frac{DPPH_{30}}{DPPH_0} \right) \times 100 \% \quad \text{---} \quad (1)$$

Where $DPPH_0$ is the initial concentration of DPPH free radicals and $DPPH_{30}$ is the concentration of DPPH free radicals after 30 minutes. AC has been expressed by the DPPH scavenging activity of noni juice.

TPC was measured with the Folin–Ciocalteu reagent. 40 µL of diluted juice was mixed with 3.16 ml of distilled water and 200 µL of Folin–Ciocalteu reagent. After keeping it for 4 minutes, 600 µL of 20% (w/v) Na_2CO_3 was added. Then, the final solution was kept for 2 hours at dark and absorbance was measured at 765 nm

with the UV-1800 Spectrophotometer. TPC was calculated with the standard curve and expressed as mg gallic acid equivalent per 1 L of noni juice. (Yang, Paulino, Janke-Stedronsky, & Abawi, 2007)

- Measurement of physical parameters with fermentation time

A food-grade, air-tight, plastic reactor was fixed with sensors of pH, temperature and humidity with an Arduino board which was programmed to run the sensors for measurements. Cleaned, ripen noni fruits were placed inside the reactor and the reactor was sealed. Program was run to start the generation of measured data.

RESULTS AND DISCUSSION

The maximum DPPH scavenging activity of the fermented noni juice was 83.84% and it was around the second week of the fermentation. DPPH scavenging activity of the fresh noni juice has been 77.06%. Therefore, AC of the extracted fresh noni juice was less than the maximum AC of the fermented noni juice. The maximum TPC of the fermented noni juice was 269.89 mg gallic acid equivalent per 1 L of noni juice and it was within the very first week of the fermentation. TPC of the extracted fresh noni juice has been 289.89 mg gallic acid equivalent per 1 L of noni juice. Therefore, TPC of the fresh noni juice was more than that of all the weekly samples from fermented noni juice. That predicts that the fresh noni juice is richer with phenolic compounds than the fermented juice. Hence AC and TPC which are directly related to the therapeutic value of noni fruit may be varied due to continuous reactions happening during fermentation process and different from the properties of fresh noni juice. (See figure 1)

Twelve days of fermentation process has

proceeded yet and physical property variation during days of fermentation has been considered. It can be observed that the temperature of the reactor environment (above the liquid juice) is lower than the liquid (juice) temperature and both are varying during the fermentation process. Both temperatures lie within the range of 30-35 °C. pH value of the juice seems to be decreasing with time from 9.65 to 8.55. Still, the juice is alkali with the pH value obtained, but the alkalinity is decreasing. Humidity has increased from 97% to 99.90% within one day and it is now seen to be constant at that value. Level of juice formed is drastically increased within the first few days and now increasing gradually over time. (See figure 2) However, several other descriptive observations and analysis can be given after the completion of this experiment. Therefore, it can be seen that physical properties have been varying with fermentation time due to the reactions happening and the products formed during the fermentation process.

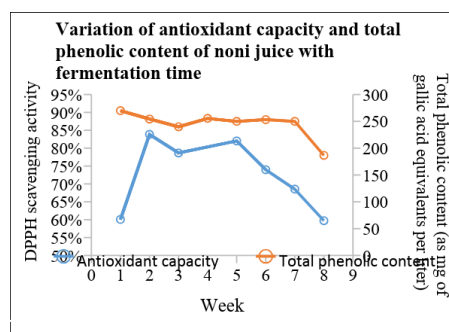


Figure 1 Variation of AC and TPC of noni juice with fermentation time

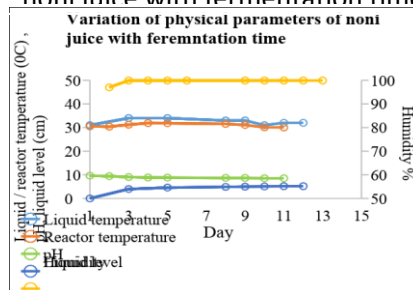


Figure 2 Variation physical parameters of noni juice with fermentation time

CONCLUSION

Due to its high antioxidant capacity and phenolic contents, the medicinal value of Noni (*Morinda Citrifolia L.*) has received greater attention around the world. (Chan-Blanco, et al., 2006). Traditional fermentation of noni juice is generally conducted up to two months. But it can be concluded that the antioxidant capacity of the fermented noni juice is maximum when it is fermented around two weeks, while the total phenolic content of the fermented noni juice is maximum when it is fermented around one week. Therefore, the therapeutic properties of traditionally fermented noni juice are drastically reduced after these optimum fermentation time periods. Variation of reactor internals and juice temperature, pH of juice, humidity of the reactor and level of noni juice formed has been considered over the fermentation period and several other critical conclusions regarding these property variations can be given after the completion of this experiment. However, further studies are required regarding the optimum fermentation conditions of noni juice in order to achieve proper therapeutic values while standardizing the widely used traditional fermentation of noni juice.

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