Scholars Journal of Engineering and Technology (SJET) **ISSN 2321-435X (Online)**
Sch. J. Eng. Tech., 2014; 2(6A):837-841 **ISSN 2347-9523 (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Research Article

Restraint of Pear Juice Browning through Pre-Treating Material with Microwave

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Abstract: Pear materials were respectively treated with 90, 270, 450, 720, and 900 W microwave power at 30, 60, 90, and 120s, and the effect of microwave pretreatment on the browning of pear juice were investigated. The results showed that the L value of pear juice originating from low power treated pear material increased, and the L value of pear juice prepared with high power treated pear material first increased and then decreased with microwave power enhancement or time extension. And the juice originating from 720W 90s treated pear material displayed the highest L value. Meanwhile, microwave pre-treating pear material might decrease the polyphenol oxidase activity of pear material and the ammonia nitrogen content of pear juice, and slightly increase the acidity of pear juice. Microwave pretreatment to pear material, as a simple and ease method, could effectively restrain the browning of pear juice.
Keywords: Pear materials, of pear juice, acidity, polyphenol oxidase, Microwave

INTRODUCTION

Pear is one of higher yield fruit in the world, and pear juice belongs to the deep processing products of pear. People are fond of pear juice owing to its rich nutrition and unique flavor [1]. However, pear juice was easy to brown during process and preservation, and the browning of pear juice includes enzymatic browning and non-enzymatic browning. Once brown occurred, the color of pear juice becomes unacceptable dark brown from attractive golden yellow. The commodity characteristics of pear juice decreased and manufacturers were subject to large loss [2]. To prevent pear juice browning, some measures were taken, such as decolorization with resin and adding anti browning agents into juice. At present, these adopted measures were cumbersome or expensive on the whole [3, 4].

Microwave, an electromagnetic wave with the length from one metre to one millimetre, can cause a high-speed rotating friction of polar molecule inside material, and much heat is generated. In addition, microwave has irradiating function. Processing food with microwave is simple and cheaper, and it is gradually popularized in food industry at present. Microwave may inactivate enzyme, heat food, or sterilize food [5].

In this experiment, the effect of microwave pre-treating pear material on the browning of pear juice was investigated. To explore the probably influencing mechanism, the PPO activity of pear material, the amino nitrogen content and acidity of pear juice were also examined. There is no report regarding the effect of microwave pre-treating pear material on pear juice browning at present. The objective is to provide related reference for pear juice processing, and expand microwave application scope in food industry as well.

MATERIAL AND METHODS

Materials

Pears (*Pyrus bretschneideri*) with physiologically mature stage were purchased from an orchard located in the vicinity of Linfen City. Sodium hydroxide, iodine and polyvinylpyrrolidone (analytically pure) were purchased Tianjin Kermel Chemical Reagent Co., Ltd. Pectinase and amylase (biochemical reagent) were supplied by Shanghai Ruji Bio-technical Co., Ltd. And Shanhai KeZhun Instrument Company supplied other reagent and experimental materials.

Instruments

WD900Y1SL23-2 Microwave oven, Shunde Galanz Electric Appliance Co., Ltd., China; WYT-II refractometer, Qingyang Optical Instrument Co., Ltd., Chendu, China; WSC-S color difference meter, Shanghai Precise Scientific Apparatus, Shanghai, China; DS–1 juicer, Shanghai Jingke Instrument Company, China; 5804R refrigerated centrifuge, Gene Co., Ltd., Germany; UV–1100 spectrophotometer, Shanghai Beauty Spectrum Instrument Co., Ltd., China.

Preparation of pear juice

Pears were cleaned and cut into small pieces and each piece was about a cubic centimetre. 500g of pear pieces was treated with microwave at certain power or time. Afterward, the treated pieces were squeezed with juicer and filtered at 260-mesh. The acquired juice was sterilized with 98^0 for 60s, quickly cooled to 51^0, and then treated for about 2 h with pectinase and amylase under 51^0 to degrade the pectin and starch [6]. The pear juice was filtered with 0.45 μm membrane and diluted to 11.5 Brix using deionised water.

Determination of pear juice browning

The degree of pear juice browning was indicated with L value determined using a color difference meter. L = 0 represents black, and L = 100 represents white [7].

Determination of acidity and ammonia nitrogen content

The acidity of pear juice was determined according to the method of Zhong *et al*. [8]. And the ammonia nitrogen content of apple juice was assayed using the method of Grissom [9].

Determination of polyphenol oxidase activity

PPO (polyphenol oxidase) activity was determined using the method of Du *et al*. [10].

Qualitative detection of pectin and starch

The pectin and starch of pear material were qualitatively determined according to the method of Chopda and Barrett [11].

Experimental design and data analysis

Pear materials were treated with 90, 270, 450, 720, and 900 W microwave power at 30, 60, 90, and 120s, respectively. And untreated material was served as control sample. There were 21 groups of samples in the experiment, and each sample was repeated three times. Data were statistically analyzed using DPS7.05, and Tukey 's method was adopted for multiple comparison. Values were expressed with mean ± SD (standard deviation).

RESULTS

Pear juice browning

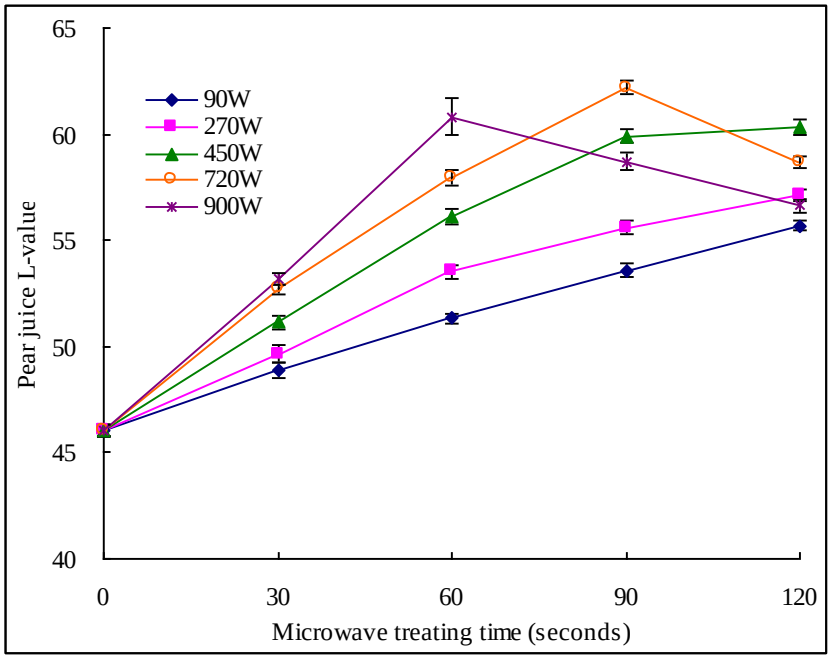

Fig. 1: Effect of microwave pretreatment on pear juice L-value

L value represents the browning degree of pear juice. Higher L value stands for lighter browning, and pear juice is golden color. Lower L value indicates severe browning, and the color of pear juice is dark brown. As shown in Figure 1, the L value of pear juice originating from pear material treated with 90, 270 and 450 W microwave increased, and the L value of pear juice originating from pear material treated with 720 or 900 W microwave firstly increased and then decreased with time extension. The pear juice of 720W 90s treated pear material displayed the highest L value 62.2, which was 34.9% higher than that of control samples. The pear juice of 900W 60s treated pear material also demonstrated higher L value, and it was 30.0% higher than that of control samples. Overall, treating pear material with higher microwave power might effectively restrain pear juice browning.

PPO activity of peach material

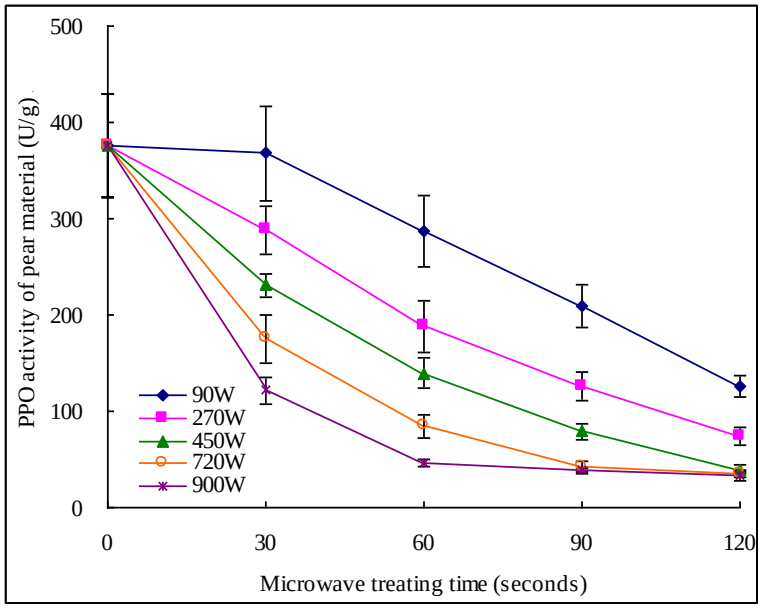

Fig. 2: Effect of microwave pretreatment on the PPO activity of pear material

As described in Fig. 2, after pear materials were treated with microwave, their PPO activities decreased with microwave power enhancement and time extension in the mass. Among them, PPO activity of 720W or 900W treated pear material rapidly decreased, reaching to lower value at 90s that was about 11% of control sample PPO activity. Though the PPO activities of 90, 270, and 450 W treated sample also declined, they were too slow. Therefore, treating pear material with higher power of microwave could usefully decreased the PPO activity of pear material, and this was beneficial to prevent the enzymatic browning of pear juice.

Amino nitrogen content of peach juice

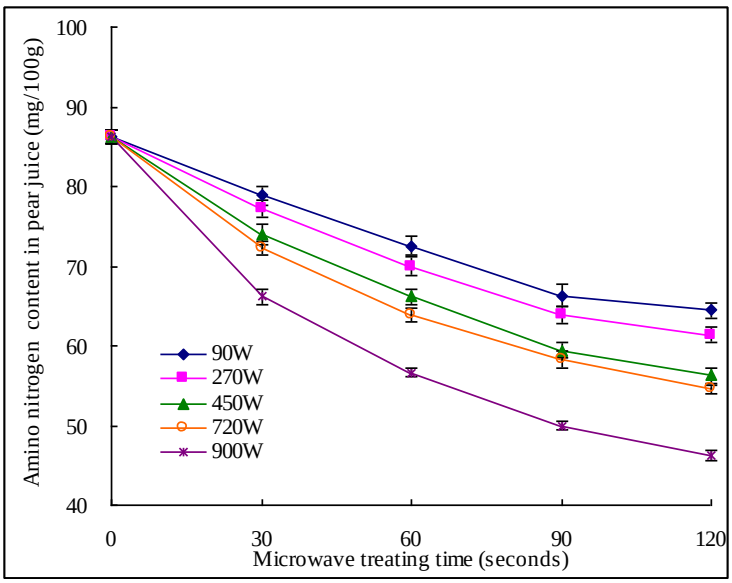

Fig. 3: Effect of microwave pretreatment on the amino nitrogen content of peach juice

The non enzymatic browning in pear juice is mainly Maillard reaction. Namely the carbonyl of reducing sugar reacts with the amino-group of amino acid, and produces Schiff base composed of much dark brown substance. Maillard reaction seriously decreases the commodity value of pear juice [12]. Compared with apple juice, pear juice contained more amino nitrogen, and Maillard reaction more certainly occurred. After Microwave treating pear material, the amino nitrogen content of pear juice decreased with microwave enhancement or time extension (Fig. 3). The pear juice originating from 900W 120s treated pear material

decreased the most amino nitrogen content, which is 86.4% lower than that of control sample. The pear juice originating from 750W 90s or 450 W 90s treated pear material also decreased more amino nitrogen content, and it was about 32.4% lower than that of control sample. 90 W or 270 W treated pear material decreased the least amino nitrogen content of pear juice. That microwave treating pear material decreased the amino nitrogen content was disadvantageous as for controlling the browning of pear juice, but microwave treating pear material could effectively inactivate the PPO activity and reduce enzymatic browning. In general, the advantage outweighed the disadvantages.

Acidity content of peach juice

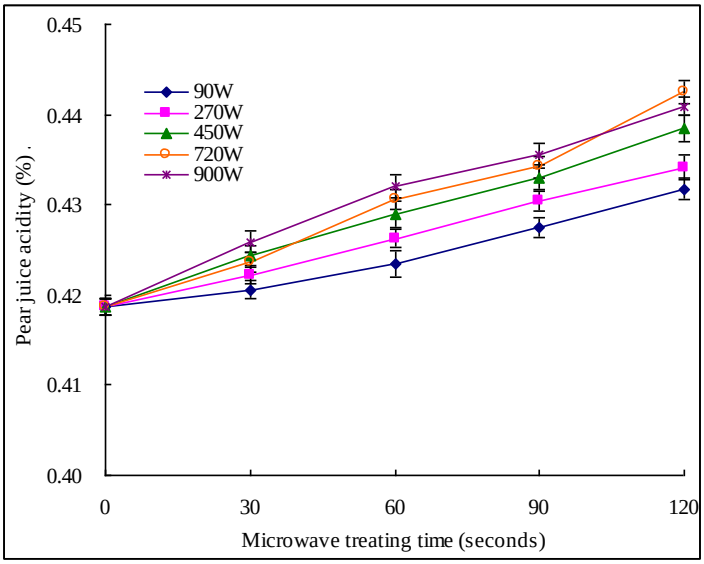

Fig. 4: Effect of microwave pretreatment on the acidity content of peach juice

Acidity is one of the characteristic flavors of pear juice. As shown in Figure 4, after pear material was treated with microwave, the acidity of pear juice generally slightly increased with microwave enhancement or time extension. The pear juice originating from 720 W 90 s and 720 W 120 s treated pear material was 3.7% and 5.7% higher than that of control sample, respectively. The increasing acidity was extremely limited, but it was crucial to control pear juice browning [13, 14].

DISCUSSION

PPO could cause juice enzymatic browning. Before fruit was smashed, PPO and its substrate located in different parts of the cell, and enzymatic browning did not occur usually. However, once fruit was smashed, PPO contacted its substrate, and enzymatic browning immediately occurred under oxygen participation [15]. Microwave pre-treating pear material could inactivate PPO, thereby restraining enzymatic browning during fruit smashing. The inactivation effect of PPO was limited in lower microwave power or shorter time. Though treating pear material with higher microwave or longer time could effectively inactivate PPO, this might cause the great loss of amino nitrogen and lead to severe Maillard reaction [12]. Through overall consideration, the moderate time and power of microwave pre-treating pear material was best suitable. In the experiment, the microwave treatment of 720W combining 90s could maximally inactivate PPO, while the retention of amino nitrogen was much more. So 720W combining 90s was the best optimum to pre-treating pear material to restrain pear juice browning.

Acidity has certain influence on juice browning. Higher acidity can restrain the PPO activity, partly decreasing enzymatic browning [13]. Maillard reaction as a non- enzymatic browning is nucleophilic reaction in fact. In higher acidity, amino group is protonated and nucleophilic reaction is blocked to a certain extent. Therefore, higher acid could also inhibit the non enzymatic browning of juice [14]. Microwave pre-treating pear material could cause the slight increase of pear juice acidity, and this was beneficial to control the enzymatic browning and non - enzymatic browning of pear juice.

CONCLUSION

Pear material was pre-treated with low power microwave, and the L value of pear juice increased with the power enhancement or time extension. While pear material was pre-treated with higher power microwave, the L value of pear juice firstly increased and then decreased with time extension. And the juice originating from treated pear material with 720W 90s microwave demonstrated the highest L value. The PPO activity of pear material and the amino nitrogen content of pear juice decreased with microwave increase or time stretch. And pear juice acidity slightly increased with microwave enhancement or time extension. Overall,

pre-treating pear material with appropriate microwave could effectively restrain the browning of pear juice.

ACKNOWLEDGMENTS

This work was supported by Program for the Innovative Talents of Higher Learning Institutions of Shanxi (2012), by project of Natural Science Foundation of Shanxi under grant no. 2012021025-3, and by project for the 131 Leading Talent of Higher Learning Institutions of Shanxi no. 447(2013).

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