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Influence of drying techniques on some compositional parameters of wood apple (*Limonia acidissima*) pulp powder

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ABSTRACT

The primary focus of this investigation was a laboratory experiment in which two methods of drying (tray dryer and microwave drying) wood apple (*Limonia acidissima*) pulp powders were compared by evaluating some compositional parameters. The Central Institute of Technology at Kokrajhar, Assam, was the location of the experiment. Tray drying at drying temperature (60^{o}C), air velocity (1.33 m^{3}/ s), loading density (1.5 cm/ m^{2}) gave the best result in terms of protein (9.12%), carbohydrate (68.44%) and total antioxidant activity (2.44%). Samples dried by microwave drying (MWD) had the shortest drying time (84 min), followed by tray dryer (TD) (870 min). The observations of drying in a microwave at a power setting of 180 W, for 66.67 min, with a loading density of 1.5 cm/m^{2} gave a protein content of 9.09 %, carbohydrate of 66.87% and total antioxidant activity of 2.32 %. In terms of retaining protein, carbohydrate and antioxidants, the results obtained using a tray drier were higher than those obtained using a microwave dryer. As a result, the utilisation of a tray dryer is suggested for the drying of wood apple pulp.

1. Introduction

Mankind have known about plants with therapeutic capabilities for thousands of years and have employed these plants as traditional medicines to treat illness (Rao *et al.,* 2011). The only member of the genus Limonia, which is part of the Rutaceae (Citrus) family, is *Limonia acidissima* (L.). *Limonia acidissima*, or wood apple, is beneficial to prevent and treat scurvy & for alleviating gastrointestinal disease. It has adaptogenic effects against blood impurities, leucorrhoea, dyspepsia, and jaundice, benefitting the liver (Narsing *et al.,* 2011). Wood apples are extremely perishable, making long-term storage problematic; an increase in moisture content is a major contributor to a decline in quality (Pisoschi & Negulescu 2011). Because the trays of a tray dryer are stacked at varying heights, it is possible to load more items into the machine. The distribution of airflow over the trays in a manner that is consistent is essential to the efficient application of the tray drier. When there is an even airflow distribution, the products' final water contents that have been dried on the trays will be consistent (Misha *et al.,* 2013). Due to their ability to dry items regardless of time or weather conditions, tray dryers are frequently employed in agricultural drying. The drying time can be cut in half with microwaves, but the product quality can be compromised as a result (Wray & Ramaswamy, 2015). Given these considerations, the goal of the this established work was to identify the most effective drying technique based on the qualitative features of dried wood apple pulp powder. Consequently, the focus of the present investigation was a laboratory experiment comparing the effects of two types of drying methods on the nutritional features (carbohydrate, protein, total antioxidant activity) of wood apple pulp powder.

2. Materials & Methods

2.1 Preparation of sample

The wood apple was procured from the local area at Kokrajhar district, the initial weight of the raw wood apple was measured in weigh balance, scooped out the pulp with seed from hard shell with the help of knife and spoon. Weight

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of pulp, outer shell and wastes/ loss was measured using weigh balance. From the obtained pulp some of the sample was taken for the analyses of quality characteristics of raw wood apple pulp. After drying of sample, wood apple pulp powder (WAPP) was obtained by grinding obtained dried pulp by using mixer grinder. The WAPP was obtained by using different dryers and was measured again using digital weighing balance.

2.2 Laboratory Experimentation

In order to carry out the laboratory experiment for WAPP production for raw wood apple as well as WAPP, nutritional properties such as moisture content, protein content, carbohydrate content were determined using standard methods and techniques. Details are presented in the following sections.

2.3 Weight of sample

Sample weight/ pulp of wood apples (g) wer measured using weigh balance in Food Quality Analysis lab c Food Engineering and Technology Department at CI Kokrajhar.

2.4 Moisture Content

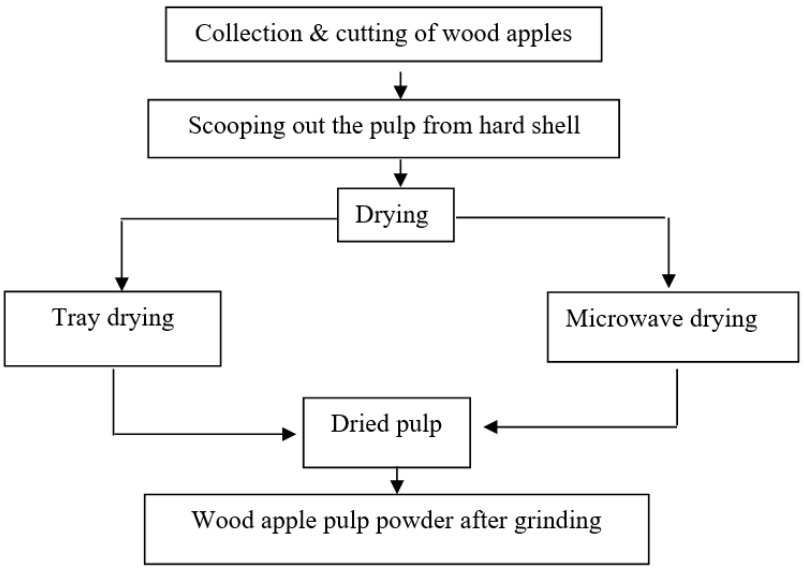
Moisture content of wood apple pulp was calculate by oven drying method using moisture box, electronic weig machine. Wood apples were collected and placed in the oven a 105˚C temperature for 24 hrs. The moisture content of fru sample on wet basis (wb) were calculated using the formu (Ileleji *et al.,* 2010).

$$\text{Mc(wb)(\%)} = \frac{\text{Initial weight of pulp(g)-Dry weight of pulp(g)}}{\text{Initial weight of pulp(g)}} \text{X } 100$$

A moisture analyzer was also used to estimate the moistu content of the wood apple for 84.06 min in Food Qualit Analysis lab of Food Engineering and Technology Departme at CIT, Kokrajhar.

Plate 1. Dried wood apple pulp and wood apple pulp powder

Flow chart 1. Extraction procedure to obtain wood apple pulp powder.



2.5 Estimation of Carbohydrate content

Fresh anthrone reagent was prepared by dissolving anthrone 0.2 g of in H_2SO_4 100 ml of & 1 mg of glucose was dissolved in 10 ml of DW (Trevelyan & Harrison, 1952). Anthrone reagent solution was blank. In five test tubes, 4 ml of anthrone reagent, glucose solution of 0.5 ml, and sample extract of 0.5 ml were added. All test tubes were wrapped in aluminium foil and heated at 85°C for 15 min. Using a spectrophotometer, the OD of blank and standard solution was measured at 620 nm. Estimation of carbohydrate than calculated using standard curve of Glucose (Pearson *et al.,* 1976).

2.6 Determination of Total Antioxidant activity

In 90 ml of methanol, sample of 10 g were added, and 10 ml of DW were combined to make 100 ml of solvent. The mixer was filtered after being stirred on a magnetic stirrer. The sample solution was then reduced using evaporator (rotary) to a 8 ml of final volume. In 100 ml of methanol, 0.0032g of DPPH was dissolved, and the prepared solution was then kept in the dark for incubation (30 mins) at room temperature. Sample extracts were diluted in six appropriate amounts using methanol. 0.5 ml of diluted extracts was placed in stopper tubes with 2.5 ml of DPPH solution in triplicate. As a control, DPPH was added to methanol. After vortexing, the solutions were incubated in the dark for 30 minutes. After half an hour, the absorbance at 517 nm was determined (Pisoschi & Negulescu, 2011).

Calculations:

$$\text{TAA (\%)} = \frac{\text{Absorbance of control-Absorbance of sample}}{\text{Absorbance of sample}} \times 100$$

2.7 Tray drying

300 g of pulp from fresh wood apple were dried at (60^{0o}C), air velocity (1.33 m^3/ s), loading density (1.5 cm/ m^2) (Dotto *et al.,* 2011).

2.8 Microwave Oven Drying

Fresh wood apple pulp weighing 300 g were dried at a power setting of 180 W for 66.67 min, with a loading density of 1.5 cm/m^2 (Sarimeseli, 2011).

3. Results and Discussion

3.1. Chemical properties of wood apple pulp

Table 1 shows the chemical properties, such as the amount of moisture, protein, carbohydrates, and TAA. From an analysis of the chemical properties of raw pulp of wood apple, it was observed to have a moisture content of 63.23% ± 3.20, a protein content of 2.67% ± 0.36, a carbohydrate content of 22.67% ± 0.31, and a TAA content of 0.14% ± 0.03. Similar results have been documented by Pandey et al. (2014).

Chemical composition of wood apple pulp powder obtained using TD and MWD shown in Table 2. It was observed that moisture content in tray dryer and microwave drying of WAPP were 5.64 (60^{o}C) and 5.01 (180 W) respectively. Moisture content was observed in higher in tray drying than microwave drying due to low microwave power. It was observed protein content in tray dryer and microwave drying of WAPP were 9.12% at 60^{o}C and 9.09% at 180 W respectively. The protein content observed maximum in tray drying than microwave drying. It was observed carbohydrate content in tray dryer and microwave drying of WAPP were 68.44 and 66.87% at 60^{o}C and at 180 W, respectively. The maximum carbohydrate content was observed in tray drying. It was observed TAA content in tray dryer and microwave drying of WAPP were 2.44 and 2.32% at 60^{o}C and at 180 W, respectively. The highest TAA content was observed in tray drying and lesser in microwave drying. Graphical representation is shown in Fig 1. Similar findings have been published by Pandey et al. (2014).

Table 1. Biochemical constituents of wood apple pulp

Sl. No.	Component analyzed	Value
1	Moisture (% wb)	63.23 ± 3.20
2	Protein (%)	13.67 ± 0.36
4	Carbohydrate (%)	22.67 ± 0.31
5	TAA (%)	0.14 ± 0.03

Values are mean ± triplicate

Table 2. Chemical composition of wood apple pulp powder obtained using TD and MWD

Component analyzed	TD	MWD
	60°C	180 W
Moisture (% wb)	5.64± 0.09	5.01±0.05
Protein (%)	9.12± 0.11	9.09 ±0.09
Carbohydrate (%)	68.44±0.23	66.87 ±0.24
TAA (%)	2.44 ± 0.03	2.32 ±0.01

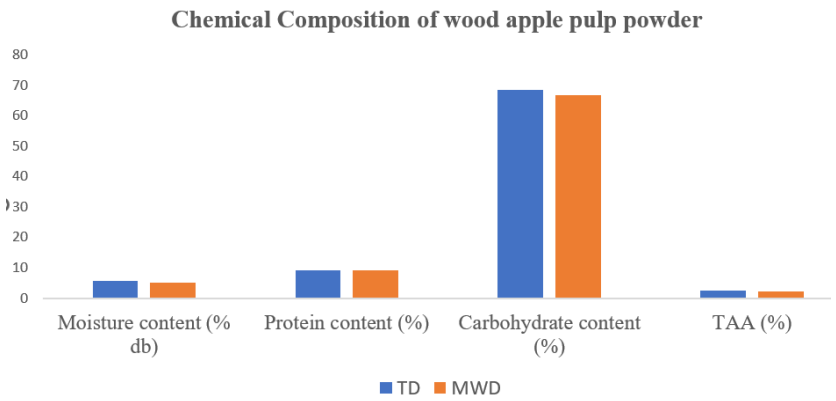


Fig 1. Chemical constituents of wood apple pulp powder

Table 3. ANOVA for Chemical constituents of wood apple pulp powder obtained using TD)

Source	Sum of Squares	Df	Mean Square	F Value	p-value Prob > F	
Model	0.545574	9	0.060619281	52.71242	< 0.0001	Significant
A-DT	0.1682	1	0.1682	146.2609	< 0.0001	
B-AV	0.00045	1	0.00045	0.391304	0.5515	
C-LD	0.0098	1	0.0098	8.521739	0.0224	
AB	0.0004	1	0.0004	0.347826	0.5739	
AC	0.0025	1	0.0025	2.173913	0.1839	
BC	0.0676	1	0.0676	58.78261	0.0001	
A^2	0.144105	1	0.144105263	125.3089	< 0.0001	
B^2	0.094737	1	0.094736842	82.37986	< 0.0001	
C^2	0.071158	1	0.071157895	61.87643	0.0001	
Residual	0.00805	7	0.00115			
Lack of Fit	0.00805	3	0.002683333			
Pure Error	0	4	0			
Cor Total	0.553624	16				
Std. Dev.	0.033912		R-Squared	0.985459		
Mean	8.845294		Adj R-Squared	0.966764		
C.V. %	0.383386		Pred R-Squared	0.767351		
PRESS	0.1288		Adeq Precision	24.89518		

Table 4. Final Formula Using Coded Variables

Variables	P	= 8.89
Temperature	-0.145	* A
Air velocity	0.0075	* B

Loading density	0.035	* C
Temperature and air velocity	0.01	* A * B
Temperature and loading density	0.025	* A * C
Air velocity and loading density	0.13	* B * C
Temperature	0.185	* A^2
Air velocity	-0.15	* B^2
Loading density	-0.13	* C^2

Table 3 displays the ANOVA statistics for output responses and their implications at the 90% level of confidence, as well as the correlation coefficients, while wood apple pulp is dried employing TD. The goodness of fit of the empirical observations in the response surface concepts of moisture content, protein, carbohydrate, and total antioxidant activity was explained by a significant correlation coefficient. The statistical model was significant ($P<0.0001$). The coefficient of determination (R^2) was 0.99. The coefficient of evaluation demonstrated that as the level of protein content, carbohydrate, and total antioxidant activity decreases with increasing temperature, increases with increasing air velocity, loading density.

4. Conclusion

It was observed that tray drying at drying temperature (60^oC), air velocity (1.33 m^3/ s), loading density (1.5 cm/ m^2) gave the best result in terms of protein (9.12%), carbohydrate (68.44%) and total antioxidant activity (2.44%). The findings showed that the samples dried by MWD had the shortest drying time (84 min), followed by TD (870 min). The observations of drying in a microwave at a power setting of 180 W, for 66.67 min, with a loading density of 1.5 cm/m^2 gave a protein content of 9.09 %, carbohydrate of 66.87% and total antioxidant activity of 2.32 %. In terms of retaining protein, carbohydrate and antioxidants, the results obtained using a tray drier were greater than those obtained using a microwave dryer. As a result, the utilisation of a tray dryer has been suggested for the drying of wood apple pulp. Fruits or vegetables which are sticky in nature, granular mass or crystalline, precipitants and pastes can be dried in a tray dryer.

5. References

Dotto GL, de Souza, VC, de Moura JM, de Moura CM, de Almeida Pinto LA (2011). Influence of drying techniques on the characteristics of chitosan and the quality of biopolymer films. Dry Technol 29(15): 1784-1791

Ileleji KE, Garcia AA, Kingsly AR, Clementson CL (2010). Comparison of standard moisture loss-on-drying methods for the determination of moisture content of corn distillers dried grains with solubles. J AOAC Int 93(3): 825-832

Jiang, B., Tsao, R., Li, Y., & Miao, M. (2014). Food safety: Food analysis technologies/techniques.

Licon, C (2022). Proximate and Other Chemical Analyses. Encyclopedia of Dairy Sciences (Third Edition), Academic Press, 521-529, ISBN 9780128187678

Misha S, Mat S, Ruslan MH, Sopian K, Salleh E (2013). Review on the application of a tray dryer system for agricultural products. World Appl Sci J 22(3): 424-433

Narsing Rao G, Prabhakara Rao PG, Govardhana Rao D (2011). Preparation of wood apple (Feronia limonia L.) seed protein concentrate and evaluation of its nutritional and functional characteristics. Int Food Res J 18(3): 949-955

Pandey S, Satpathy G, Gupta, RK (2014). Evaluation of nutritional, phytochemical, antioxidant and antibacterial activity of exotic fruit" *Limonia acidissima*". J. pharmacogn. phytochem: 3(2).

Pearson D, Melon HK, Ronald S (1976). Chemical analysis of Food, 8th edition. Churchill Livingstone.Pp 5-63

Pisoschi AM, Negulescu GP (2011). Methods for total antioxidant activity determination: a review. Biochem Anal Biochem 1(1): 106

Rao N, Prabhakara Rao PG, Rao G (2011). Preparation of wood apple (*Feronia limonia* L.) seed protein concentrate and evaluation of its nutritional and functional characteristics. Int Food Res J 18(3)

Sarimeseli A (2011). Microwave drying characteristics of coriander (*Coriandrum sativum L.*) leaves. Energy Convers 52(2):1449-1453

Trevelyan WE, Harrison JS (1952). Studies on yeast metabolism. 1. Fractionation and microdetermination of cell carbohydrates. Biochem J 50(3): 298

Vidhya R, Narain A (2011). Development of preserved products using under exploited fruit, wood apple (Limonia acidissima). Am J Food Technol 6(4): 279-288.

Wray D, Ramaswamy HS (2015). Novel concepts in microwave drying of foods. Dry Technol 33(7): 769-783