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Optimization of hot air drying conditions of purple-fleshed potato

Mor etli patatesin sıcak hava kurutma koşullarının optimizasyonu

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Abstract

One of the most popular techniques for preserving fruits and vegetables is drying. Many drying methods have advantages and disadvantages. The purpose of this study was to optimize the hot air drying conditions of a novel variety of purple-fleshed potatoes with the response surface method (RSM) by considering the duration of the steaming process applied before drying, slice thickness, and drying temperature. The optimum drying conditions were determined by analyses such as total phenolic compound, antioxidant activity, chroma, and starch ratio in purple-fleshed potato powders obtained as a result of drying by considering different drying temperatures (55, 65, 75 °C), steam blanching times (2, 5, 8 min) and slice thickness (2, 4, 6 mm). Following optimization, it was discovered that the drying temperature, slice thickness, and steam blanching time were, respectively, 55 °C, 5.80 mm, and 4 minutes. Consequently, the generated product experiences reduced discoloration, quality loss, and reduction of bioactive components.

Keywords: Hot air drying. Purple-fleshed potato. Bioactive components. RSM.

Öz

Meyve ve sebzeleri muhafaza etmek için kullanılan en popüler tekniklerden biri kurutmadır. Bir çok kurutma tekniğinin avantajı ve dezavantajı vardır. Son ürünün kalitesi, seçilen kurutma tekniğinden etkilenebilir. Bu çalışmanın amacı, yeni bir mor etli patates çeşidinin sıcak hava kurutma koşullarını, kurutma öncesi uygulanan buharda haşlama işleminin süresi, dilim kalınlığı ve kurutma sıcaklığını dikkate alarak yanıt yüzey yöntemi (RSM) ile optimize etmektir. Kurutma sonucunda elde edilen mor etli patates tozlarında farklı kurutma sıcaklıkları (55, 65, 75 °C), buharda haşlama süreleri (2, 5, 8 dk) ve dilim kalınlıkları (2, 4, 6 mm) dikkate alınarak toplam fenolik bileşik, antioksidan aktivite, kroma ve nişasta oranı gibi analizler yapılarak optimum kurutma koşulları belirlenmiştir. Optimizasyonun ardından kurutma sıcaklığı, dilim kalınlığı ve buharda haşlama süresi sırasıyla 55 °C, 5,80 mm ve 4 dakika olarak bulunmuştur. Sonuç olarak, üretilen üründe daha az renk değişikliği, kalite kaybı ve biyoaktif bileşenlerde azalma görülür.

Anahtar kelimeler: Sıcak hava kurutma. Mor etli patates. Biyoaktif bileşenler. Yanıt yüzey yöntemi.

1 Introduction

Potatoes (*Solanum tuberosum* L.), which belong to the Solanaceae family, are the fourth most popular staple food after rice, wheat, and corn [1]. The world is changing and evolving, and consumers are becoming more interested in eating healthily. At this point, potatoes respond to the demands of consumers in this regard with the nutrients (carbohydrates, dietary fibre, vitamins, and mineral content) they contain [2]. Many studies have shown that these substances are beneficial in preventing a wide range of diseases (such as cancer, heart disease, allergies, and neurological disorders) [3-5]. Moreover, they contain significant bioactives such as anthocyanins and phenolic compounds. depending on the type [6]. Especially purple-fleshed potatoes (PFP) represent a natural source of anthocyanins rich in anthocyanins in the form of acylated glycosides such as petunidin, malvidin, peonidin, and delphinine [6] and so with the ever-increasing demand for healthy foods. Purple-fleshed potatoes have attracted the attention of researchers [7] However, as noted by Tonon et al. [8] and Musilova et al. [9], anthocyanins are very sensitive to several environmental and process factors. including temperature, light, pH, and oxygen. As a result, they degrade quickly and become unwanted, colorless brown chemicals [10]. Foods that include bioactives, such as anthocyanins, require special consideration during food processing. One of the most often used and popular methods of food preservation in the food industry is drying. In summary, the process of drying involves the evaporation of water from food materials due to heat transfer energy, usually under regulated circumstances. Drying aims to reduce the moisture percentage of fruits and vegetables from 80–95% to 10–20% by reducing water activity. Thus, the dried product becomes microbiologically, enzymatically, and chemically stable and can be stored longer. On the other hand, the drying process can have many negative effects, such as loss of nutrients, color, taste, and texture in food. The most popular technique for dehydrating food is traditional drying, which uses heated airflow to eliminate moisture from food. However, in order to minimize these negative effects, many drying techniques have been developed, and drying conditions have been optimized. The most popular technique

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for dehydrating food is traditional drying, which uses heated airflow to eliminate moisture from food. Hot air drying is not always the optimum drying technique, despite its low cost and ease of use [11]. Occasionally, food materials require high temperatures and time for drying, resulting in a loss of color, texture, and nutrients. Jing et al. [12] found that among the various drying processes, the hot air drying method had the lowest levels of antioxidant activity and phenolic compounds.

To achieve optimal system efficiency and dried product quality at the lowest possible cost and time is the aim of optimizing the food drying process [13-14]. Response surface methodology (RSM), a collection of statistical and mathematical techniques, is a useful tool for the creation, enhancement, and optimization of food processes [15-16]. RSM has been widely used in the optimization of drying foods with different methods including the Microwave–Conventional drying of sweet potato [17], the convective–infrared drying of turnip slices [18], the convective air drying of pumpkin seeds [19], the combined microwave–hot air drying of purple cabbage [20].

The purpose of this study was to use RSM to ascertain the hot air drying conditions of the first domestic and national variety, the purple-fleshed potato (ilk mor).

2 Materials and methods

2.1 Sample preparation

Purple-fleshed potatoes were kept at +4°C in a storage room after being provided by the Faculty of Agricultural Sciences and Technologies at Nigde Omer Halisdemir University. Purple flesh-colored potato samples were first washed and peeled. Then, according to the experimental design, the slice thicknesses and steam boiling time were determined, and the samples were dried in the hot air drying cabinet (Isotex) until the moisture value reached around 10% after steaming.

2.2 Experimental design

RSM was used to optimize drying conditions. The box-Behnken model was selected for RSM analysis. The effect of three independent process parameters: thickness (X_1, mm). drying temperature (X_2,T). and steam blanching time (X_3, t) were examined using RSM. The total number of hot air-drying of purple-fleshed potato experiments was 15, and three replicates at the centre point of the design were done Center point: drying temperature; slice thickness; steam blanching time: 65 °C, 4 mm, 5 minutes, respectively (Table 2).

Minitab 17.1.0.0 was used for the experimental design, data analysis and regression modelling. The independent variables were; X_1 (2, 4 and 6 mm). X_2 (55, 65 and 75°C). and X_3 (2, 5, and 8 min). The proposed model is shown in Eq.(1).

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_{11}X_{11} + b_{22}X_{22} + b_{33}X_{33} + b_{12}X_{12} + b_{13}X_{13} + b_{23}X_{23} \quad (1)$$

Table 1. Limit and level values of independent variables for hot air drying

Variables	Coding level's actual values		
	-1	0	+1
Drying temperature (°C)	55	65	75
Slice thickness (mm)	2	4	6
Steam blanching time (min)	2	5	8

Where Y was the response of the equation. Response values were included in the equation as TPC, AA, TMA, chroma, and starch ratio. b_0 was the constant coefficient. b_1. b_2. and b_3 were the linear coefficients. b_{11}, b_{22} and b_{33} were the quadratic coefficients. b_{13}, b_{23} and b_{12} were the interaction coefficients. The values of R^2 adjusted-R^2 and lack-of-fit of models were evaluated to check the model adequacies.

Table 2. Response surface method trial design for hot air drying application

Trial no	Drying temperature (°C)	Slice thickness (mm)	Steam blanching time (min)
1	65	2	8
2	65	6	2
3	65	4	5
4	65	6	8
5	55	6	5
6	75	4	8
7	65	2	2
8	65	4	5
9	65	4	5
10	75	4	2
11	75	2	5
12	75	6	5
13	55	2	5
14	55	4	2
15	55	4	8

2.3 Steam blanching time

One pre-treatment technique that reduces quality losses during drying is steam blanching. Consequently. the Box-Behnken model's steam blanching time of 90±2 °C was followed for this study's steam blanching procedure.

2.4 Solvent extraction

Bioactive compounds from potato powders were extracted using methanol (80 % Sigma, Germany) containing 1% HCl (Honeywell, Germany). Purple-fleshed samples were mixed with extraction solution at a dilution rate of 1g/50 mL. Samples, extracted at room temperature for 1 day were used for analysis.

2.5 Total Phenolic Content (TPC)

The TPC of the dried potato sample was determined using the Folin-Ciocalteu method [21].

2.6 Antioxidant Activity (AA)

Antioxidant activity was determined using the DPPH method with minor modifications [22].

2.7 Total Monomeric Anthocyanin (TMA) content

The total monomeric anthocyanin content of the samples was measured by the pH differential method [23].

2.8 Color

*L**, *a** and *b** values were determined using the Konica-Minolta (CR400. Osaka. Japan) colorimeter [24]. For each potato slice, readings were taken at least three different points.

2.8.1. Chroma

Chroma values were calculated using Equation (2) to determine the effect of drying on the purple-fleshed potatoes.

$$\text{Chroma} = C^* = [(a^*)^2 + (b^*)^2]^{1/2} \tag{2}$$

2.9 Determination of starch ratio

The starch ratio was measured as described previously [23]. The determined optical rotation degree was substituted in Equation (3) to calculate the starch ratio (%).

$$\%\ Starch = \frac{\alpha.2000}{(a)_{20}^{D}.L} \tag{3}$$

α: The degree of rotation read on the polarimeter

$(a)_{20}^{D}$: Specific degree of conversion of potato starch

L: Polarimeter tube length

2.10 Statistical analysis

The data were analysed using Minitab (Minitab 17.1.0.0. State Colage. PA. USA) statistical software with a 95% confidence interval and the general linear model was used in the analysis of the data. Tukey's multiple comparison test was used to determine whether there was a significant difference between the groups. Each experiment was repeated three times.

Table 3 Data on total phenolic content. antioxidant activity. chroma. total monomeric anthocyanin content and starch ratio obtained as a result of the analysis of purple-fleshed potato powders.

Trial no	Drying Temperature (°C)	Slice Thickness (mm)	Steam blanching time (min)	TPC (mg GAE/kg DW)	Antioxidant activity (% inhibition)	Chroma	Starch Ratio (%)	TMA content
1	65	2	8	2291.50±69.57	25.19±0.47	15.90±1.53	77.26±0.80	1784.10±38.07
2	65	6	2	2840.46±54.52	27.85±0.46	14.36±0.9	82.03±2.05	1638.68±9.83
3	65	4	5	3189.94±9.62	27.31±0.02	17.29±6.49	80.21±0.07	2075.91±41.64
4	65	6	8	2416.09±48.96	26.13±0.47	13.75±0.12	73.84±0.76	1447.08±41.77
5	55	6	5	3144.30±60.45	35.17±0.41	16.96±4.58	77.75±0.80	2638.73±48.54
6	75	4	8	2786.80±7.04	27.305±0.46	13.04±1.22	71.84±0.68	1707.30±57.71
7	65	2	2	2628.47±71.38	28.189±0.45	16.75±2.63	73.84±0.76	2131.16±63.05
8	65	4	5	3243.61±21.58	27.00±0.46	16.90±2.98	80.78±2.08	1857.41±17.13
9	65	4	5	3341.80±69.24	27.27±0.46	16.95±3.65	80.11±4.6	2054.49±10.30
10	75	4	2	2612.13±46.40	27.07±0.46	9.09±2.57	76.28±0.79	1348.58±44.35
11	75	2	5	2440.83±34.56	31.34±0.44	15.53±0.56	75.79±0.786	1824.26±26.60
12	75	6	5	2768.63±68.47	29.12±0.45	9.15±0.77	74.75±1.37	1642.32±29.90
13	55	2	5	3122.52±58.72	29.75±0.44	16.11±4.01	73.13±3.12	2767.97±44.06
14	55	4	2	3259.73±49.93	28.94±0.45	16.74±0.63	72.81±1.37	2475.20±9.82
15	55	4	8	2965.22±34.71	27.12±0.63	14.92±0.97	76.28±0.79	2070.64±3.34

Table.4 Model coefficients formed by the data of total phenolic content. chroma. antioxidant activity. starch and total monomeric anthocyanin content were obtained as a result of the analysis of purple-fleshed potato powders.

Symbols	TPC (mg GAE/ kg DW)		Chroma		AA		Starch Ratio(%)		TMA content	
	Coefficients	p	Coefficients	p	Coefficients	p	Coefficients	p	Coefficients	p
β_0 Fixed	3258.5	0.000*	17.053	0.000*	27.198	0.000*	80.371	0.000*	1995.9	0.000*
β_1 Drying Temperature (T)	-235.4	0.002*	-2.239	0.000*	-0.768	0.039 *	-0.164	0.526	-428.8	0.001*
β_2 Slice Thickness (L)	85.8	0.096	-1.261	0.002*	0.475	0.147	1.043	0.007*	-142.6	0.047*
β_3 Steam blanching time (t)	-110.1	0.046*	0.084	1.00	-0.789	0.036*	-0.718	0.030*	-73.1	0.237
β_{11} T*T	-13.8	0.832	-2.178	0.001	2.462	0.002*	-3.723	0.000*	186.3	0.067
β_{22} L*L	-375.6	0.002*	-0.434	0.244	1.691	0.009*	-1.285	0.015*	36.1	0.671
β_{33} t*t	-338.7	0.003*	-1.425	0.007*	-2.048	0.004*	-2.338	0.001 *	-281.8	0.017
β_{12} T*L	76.5	0.253	-1.808	0.002*	-1.909	0.005*	-1.414	0.009*	-13.2	0.871
β_{13} T*t	117.3	0.104	1.445	0.006*	0.516	0.245	-1.979	0.002*	190.8	0.056
β_{23} L*t	-21.8	0.727	0.060	0.858	0.319	0.453	-2.905	0.000*	38.9	0.635
The Importance of the Model	0.006*		0.001*		0.005*		0.001*		0.009*	
Lack of fit	0.243		0.068		0.028		0.169		0.344	
R^2 (%)	95.71		98.00		96.25		98.38		95.09	
R^2_{adj} (%)	87.99		94.41		89.51		95.47		86.24	

3 Results and discussion

Table 3 provided an overview of the physicochemical characteristics of purple-fleshed potato powders that had been hot air-dried. These acquired data were used to carry out the optimization process. Simultaneously, each experimental data set's model coefficients for optimization were generated and displayed in Table 4 also lack of fit values is shown in Table 4. The insignificant lack of fit for TPC (P = 0.243 > 0.05), Chroma (P = 0.068 > 0.05), Starch Ratio (%) (P = 0.169 > 0.05), TMA content (P = 0.344> 0.05) also showed that the model fit the experimental data well.

3.1 Effect of process parameters on TPC

The TPC of purple-fleshed potato powders was found in the range between 2291.50 to 3341.80 mg GAE/100 kg DW (Table 3). RSM analysis showed that the individual effects of drying temperature and steam blanching time on TPC were found to be significant ($p \leq 0.05$) (Table 4). High drying temperature had a negative effect ($p<0.05$) on the TPC of purple-fleshed potato powder (Table 4). As the temperature increased, the amount of total phenolic compound decreased (Figure 1). Similar results were recorded in some fruits in which the amount of phenolic compound decreased with increasing temperature [25]. Since the polyphenols have been found to be heat-sensitive compounds, applying heat treatments can significantly lower the phenolic content of foods [26]. In another study, apple peel was dried using hot air drying, and the amount of phenolic compounds increased with decreasing temperature [27]. Furthermore, steam blanching time increased the amount of phenolic compounds up to a certain point and then decreased (Figure 1). Research has generally attempted to mitigate the adverse effects of heat treatment by pre-treatment with steaming [28]. In addition to the fact that steaming facilitates the evaporation of water from tissues, previous research has shown that inactivating polyphenol oxidase enzymes better preserve phenolic compounds [29]. However, because the high temperature broke down the phenolic compounds, the amount of phenolic compounds decreased with longer steam blanching times (Figure 1).

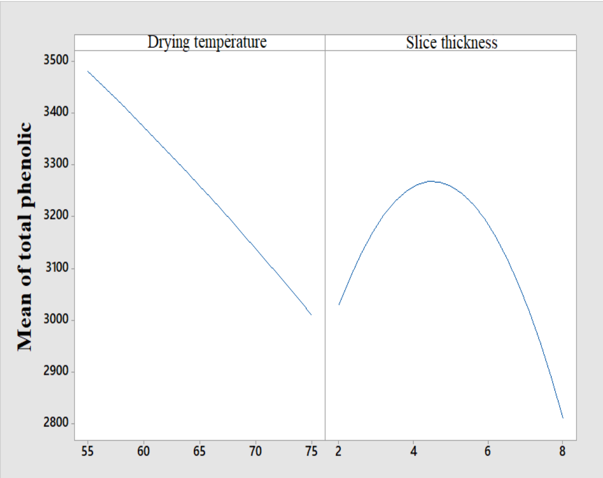


Figure 1. Effect of drying temperature and steam blanching time on the total phenolic component of the powdered purple-fleshed potato

3.2 Effect of process parameters on antioxidant activity

Antioxidant activity (inhibition %) of hot air-dried purple-fleshed potato powder was from 25.19 to 35.17 % (Table 3). Upon examining the model displaying the antioxidant activity values, it was seen that the independent variables of drying temperature and steam blanching time alone had a statistically significant influence ($p < 0.05$) and these independent variables were found to have a negative effect. (Table 4). Increasing temperature and steam blanching time decreased antioxidant activity. The results of the influence on phenolic components and the antioxidant activity value were comparable. Because phenolic compounds are in fact naturally occurring antioxidants, similar outcomes were seen [30]. Moreover, it was shown that the drying temperature and slice thickness interaction was significant ($p<0.05$) (Table 4). Accordingly, the antioxidant activity value increased with the application of high slice thickness and a low drying temperature (Figure 2). Antioxidant activity increased due to the favourable effect of low temperature and high slice thickness on the preservation of phenolic compounds. Papoutsis et al. [31] found that the total phenolic compounds of a 5 mm-thick sliced hot air-dried sweet potato increased at 65 °C at the end of 9 hours, thus increasing the antioxidant activity. A higher level of TPC in dried foods may be observed as a result of the cellular damage that occurs during the dehydration process, which accelerates the release of phenolic chemicals.

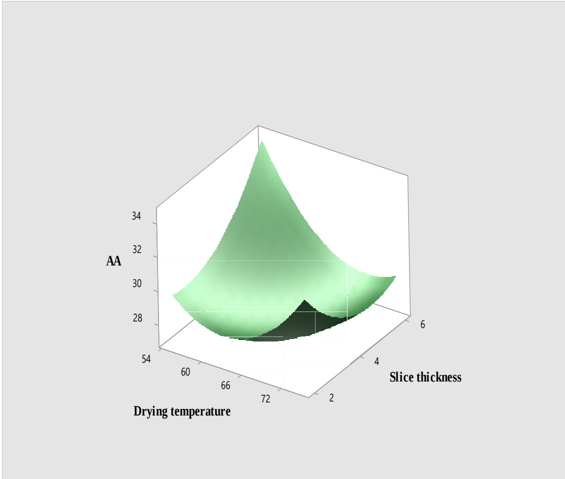


Figure 2. Effect of drying temperature and slice thickness on antioxidant activity

3.3 Effect of process parameters on starch ratio (%)

One of the primary nutrients in foods like potatoes is starch. The starch ratio of hot air-dried purple-fleshed potato powder was from 71.84 to 82.03% (Table 3). The effect of slice thickness and steam blanching time alone among the independent variables was found to be statistically significant ($p < 0.05$) when the model displaying the starch values was analyzed (Table 4). In addition to these, the interactions expressing the interactions of the treatment conditions with each other were found to be significant ($p \leq 0.05$) (Table 4). When applying low steam blanching times and high slice thicknesses, the starch value increased (Figure 3). Starch is extremely vulnerable to shear, high temperatures, amylolytic degradation, and retrogradation in its natural state. The heat treatment breaks the starch chain. According to Trancoso-Reyes et al. [32], pre-treatments with steam and microwaves could cause the crystalline region of starch to be damaged and the structure of the sweet potato flour matrix to reorganize. Therefore, a moderate steam blanching time improved the starch content. (Figure 3)

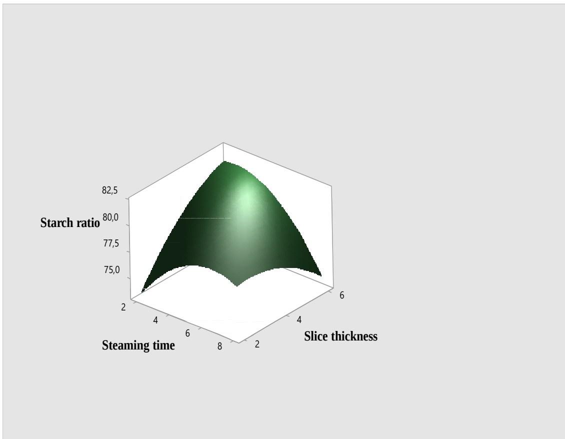


Figure 3. Effect of slice thickness and steam blanching time on starch ratio

3.4 Effect of process parameters on total monomeric anthocyanin amount

While food is drying, a lot of unstable bioactive chemicals can break down; anthocyanin is one of the most readily broken down molecules. The anthocyanin amounts of hot air-dried purple-fleshed potato powder were in the range of 1348.58 to 2767.97 mg cyanidin-3-glucoside / kg DW (Table 3). According to the RSM analysis (Table 4), linear terms of drying temperature and slice thickness were found to have a significant ($P<0.05$) impact on TMA content. Slice thickness and drying temperature had a negative effect on anthocyanin content. The anthocyanin amount was shown to decrease with increasing drying temperature and slice thickness (Figure 4). Similarly, Liu et al. [33] reported that drying temperature has an effect on anthocyanin degradation. Studies have shown that as slice thickness increases, the amount of anthocyanins—bioactive substances that are heat-sensitive—decreases, lengthening the drying period considerably [34].

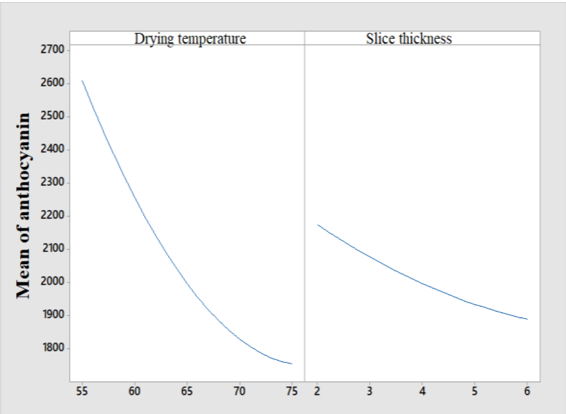
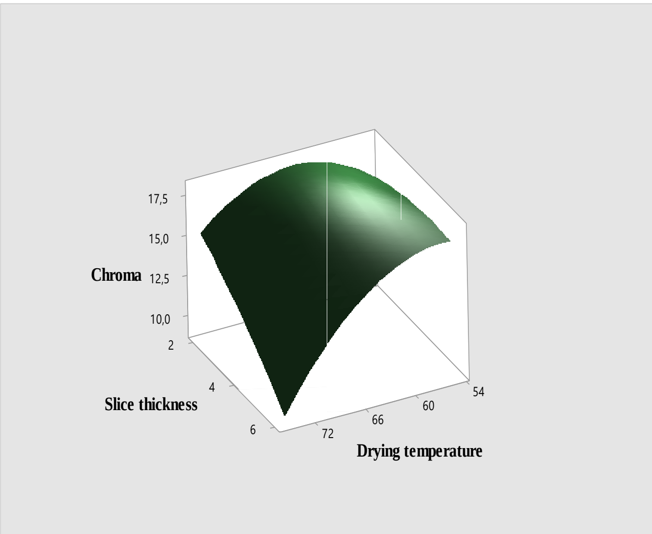


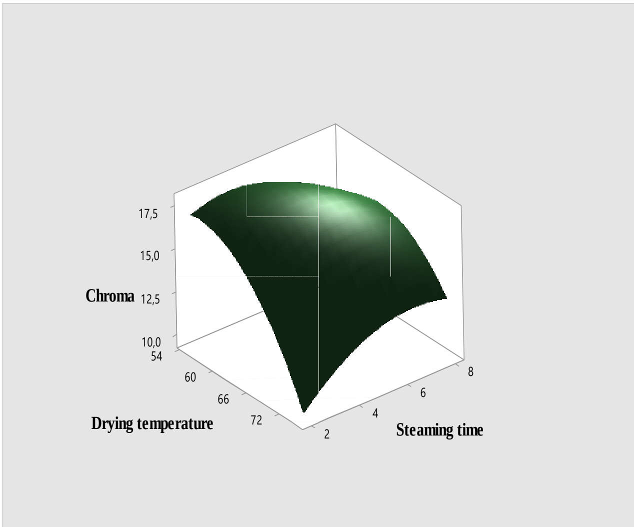
Figure 4. Effect of drying temperature and slice thickness on anthocyanin amount

3.5 Effect of process parameters on chroma

One sensory factor that has a big impact on food preference is color stability can be affected by thermal processes and process factors. The qualities of color are influenced by pretreatment and combination drying processes. The chroma value is usually an important color parameter in colored foods. Chroma value of hot air-dried purple-fleshed potato powder was from 9.09 to 17.29 (Table 3). According to the RSM analysis (Table 4), linear terms of drying temperature and slice thickness were found to have a significant ($P<0.05$) impact on chroma value. Upon analyzing the graph depicting the correlation between drying temperature and slice thickness and the chroma value of purple-fleshed potato powder (Figure 5-a), it can be observed that a higher chroma value is achieved when low drying temperature and high slice thickness are applied. Moreover, the chroma value rose in low steam blanching time and low drying temperature application, as shown by the graph (Figure 5-b) illustrating the impact of drying temperature and steam blanching time on the chroma value of purple-fleshed potato powder. While other factors like air velocity, shape, size, and moisture content are equally effective, temperature has been proven to be the most significant component that directly affects drying kinetics in conventional drying [35]. It is thought that the decrease in thickness causes surface hardening that prevents moisture diffusion, and thus a decrease in chroma value occurs due to the need for longer drying times [34]. Extended drying periods cause certain chemical reactions, including enzymatic browning, the Maillard reaction, and caramelization, which lower L*, a*, and b* values [36]. The enzyme responsible for enzymatic browning is polyphenol oxidase, therefore regarding the effect of steam blanching time, this situation was associated with the inhibition of polyphenol oxidase depending [37,38]. Savas et al. [39] reported similar results.



(a)



(b)

Figure. 5. Effect of drying temperature; slice thickness(a) and steam blanching time (b) on chroma value

3.6 Determination of optimum drying conditions

The best drying conditions were selected in order to enhance the powder's quality. Total phenolic content (TPC), Antioxidant activity (AA), Total monomeric anthocyanin (TMA) content, starch ratio, and chroma values were optimized for this reason. As a result of this, Optimum hot air-drying conditions for purple-fleshed potatoes were determined as 55 °C, 5.80 mm and 4 minutes (Figure 6). The comparison of experimental and theoretical results was found to be relatively close which indicated the high reliability of the model as reported in Table 5.

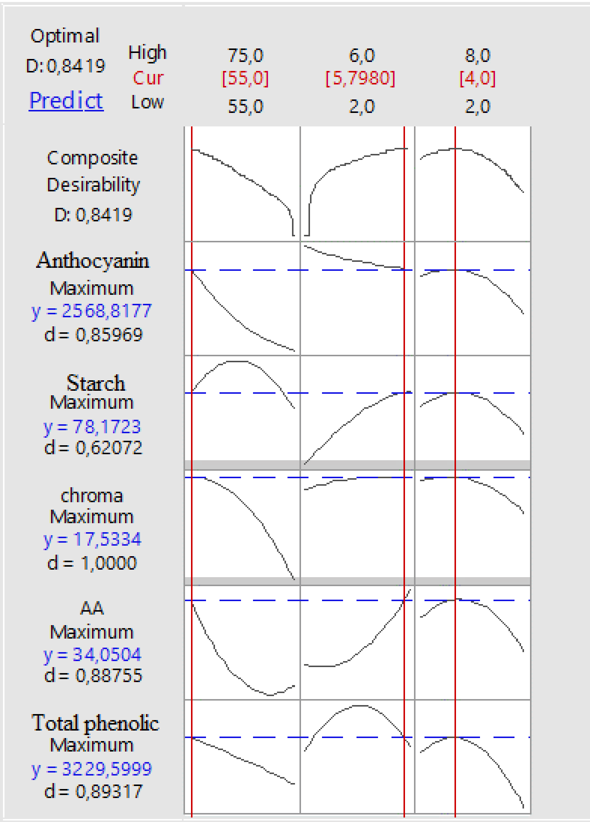


Figure 6. Hot air drying optimization graph for potatoes with purple-flesh color

Table 5. Comparison of theoretical and experimental results of optimum drying conditions

Analyses	Predicted	Experimental results	CV (%)
Total phenolic content	3229,59	3144,30±60,45	1.89
Chroma	17,53	16,39±0,06	4.75
Antioxidant activity	34,05	32,26±0,62	3.82
Starch Ratio (%)	78,17	79,23±2,86	0.95
Total monomeric anthocyanin	2568,81	2623,39±288,89	1.49

4 Conclusion

Purple-fleshed potatoes were dried in a hot air dryer under various circumstances based on an experimental design in this study. RSM was utilized to examine and maximize how hot-air dryer parameters affected the quality of the final product. The drying temperature, slice thickness, and steam blanching time were the optimized parameters. It was seen that alone and the interaction of these parameters affect the drying in different directions. To ascertain the effects of several parameters influencing the drying conditions and to combine these conditions under a single parameter, optimization with RSM proved to be a viable alternative. From the results obtained in this study, the optimum points for hot air drying conditions of purple-fleshed potatoes were found. Furthermore, even though the drying conditions had separate effects, a clear result was achieved from the optimization since these effects were assessed as a triple parameter. At the same time, it is thought that the optimization of purple-fleshed potatoes, which is a new variety made by hot air drying, provides new data to the literature.

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Conflicts of Interest

The authors declare no conflict of interest.

Similartiy rate (iThenticate): 19%

Reference

[1] Qiu. Gan, Y. L. Jiang and Deng. Yun, Drying characteristics. functional properties and in vitro digestion of purple potato slices dried by different methods. Journal of Integrative Agriculture. 18(9). 2162-2172, 2019. https://doi.org/10.1016/S2095-3119(19)62654-7

[2] K. Zaheer and M. Akhtar, Potato production. usage and nutrition-a review. Journal of Critical Reviews in Food Science and Nutrition, 56(5), 711-721, 2016. DOI: 10.1080/10408398.2012.724479

[3] H. Cory, S. Passarelli, J. Szeto, M. Tamez and J. Mattei, The role of polyphenols in human health and food systems: A mini-review. Frontiers in Nutrition, *5*, 87, 2018. https://doi.org/10.3389/fnut.2018.00087

[4] Y. Zhou, J. Zheng, Y. Li, D. P. Xu, S. Li, Y. M. Chen and H. B. Li, Natural polyphenols for prevention and treatment of cancer. Nutrients, 8(8), 515, 2016. https://doi.org/10.3390/nu8080515

[5] A. Singh, S. Holvoet and A. Mercenier, Dietary polyphenols in the prevention and treatment of allergic diseases. Clinical & experimental allergy,41(10), 1346-1359, 2011. https://doi.org/10.1111/j.1365-2222.2011.03773.x

[6] C. Brown, Antioxidants in Potato AJPR 82:163–172, 2005.

[7] J. Tian, J. Chen, F. Lv, S. Chen, J. Chen, D. Liu and X. Ye, Domestic cooking methods affect the phytochemical composition and antioxidant activity of purple-fleshed potatoes. Food Chemistry, 197, 1264-1270, 2016. https://doi.org/10.1016/j.foodchem.2015.11.049

[8] R.V. Tonon, C. Brabet and M. D. Hubinger, Anthocyanin stability and antioxidant activity of spray-dried açai (Euterpe oleracea Mart.) juice produced with different carrier agents. Food Research International, 43:907–914, 2010. https://doi.org/10.1016/j.foodres.2009.12.013

[9] J. Musilova, J. Lidikova, A. Vollmannova, H. Frankova, D. Urminska, T. Bojnanska and T. Toth, Influence of heat treatments on the content of bioactive substances and antioxidant properties of sweet potato (Ipomoea batatas L.) tubers. Journal of Food Quality, 2020. https://doi.org/10.1155/2020/8856260

[10] A. Patras, N. P. Brunton, C. O'Donnell and B. K. Tiwari, Effect of thermal processing on anthocyanin stability in foods; mechanisms and kinetics of degradation. Trends in Food Science & Technology, 21(1), 3-11, 2010. https://doi.org/10.1016/j.tifs.2009.07.004

[11] E. Karacabey, M. S. Bardakcı and H. Baltacıoglu, Physical pretreatments to enhance purple-fleshed potatoes drying: effects of blanching ohmic heating and ultrasound pretreatments on quality attributes. Potato Research, 1-26, 2023. https://doi.org/10.1007/s11540-023-09618-8

[12] Y. Jing, J. F. Chen, Y. Y. Zhao and L. C. Mao, Effects of drying processes on the antioxidant properties in sweet potatoes. Agricultural Sciences in China, 9(10). 1522-1529. 2010. https://doi.org/10.1016/S1671-2927(09)60246-7

[13] M. Yolmeh and S. M. Jafari, Applications of response surface methodology in the food industry processes. Food and Bioprocess Technology, 10(3), 413-433, 2017. https://DOI10.1007/s11947-016-1855-2

[14] M. Amiripour, M. B. Habibi-Najafi, M. Mohebbi and B. Emadi, Optimization of osmo-vacuum drying of pear (Pyrus communis L.) using response surface methodology. Journal of Food Measurement and Characterization, 9, 269-280, 2015. https://DOI10.1007/s11694-015-9232-9

[15] Z. Šumić, A. Vakula, A. Tepić, J. Čakarević, J. Vitas and B. Pavlić, Modeling and optimization of red currants vacuum drying process by response surface methodology (RSM). Food Chemistry, 203, 465-475, 2016. https://doi.org/10.1016/j.foodchem.2016.02.109

[16] A. O. Omolola, A. I. O. Jideani, P. F. Kapila and V. A. Jideani, Optimization of microwave drying conditions of two banana varieties using response surface methodology. Food Science and Technology, 35, 438-444, 2015. https://doi.org/10.1590/1678-457X.6700

[17] S. Tufekci and S. G. Özkal, The Optimization of hybrid (microwave–conventional) drying of sweet potato using response surface methodology (RSM). Foods, 12(16), 3003, 2023. https://doi.org/10.3390/foods12163003

[18] E. Taghinezhad, M. Kaveh and A. Szumny, Optimization and prediction of the drying and quality of turnip slices by convective-infrared dryer under various pretreatments by RSM and ANFIS methods. Foods, 10(2), 284, 2021. https://doi.org/10.3390/foods10020284

[19] D. Zalazar-Garcia, M. C. Román, A. Fernandez, D. Asensio, X. Zhang, M. P. Fabani and G. Mazza, Exergy, and sustainability assessments applied to RSM optimization of integrated convective air-drying with pretreatments to improve the nutritional quality of pumpkin seeds. Sustainable Energy Technologies and Assessments, 49, 101763, 2022. https://doi.org/10.1016/j.seta.2021.101763

[20] J. Liu, X. Li, Y. Yang, H. Wei, L. Xue, M. Zhao and J. Cai, Optimization of combined microwave and hot air drying technology for purple cabbage by Response Surface Methodology (RSM). Food Science & Nutrition, 9(8), 4568-4577. 2021. https://doi.org/10.1002/fsn3.2444

[21] H. Baltacıoglu, C. Baltacıoglu, I. Okur, A. Tanrıvermis and M. Yalıc, Optimization of microwave-assisted extraction of phenolic compounds from tomato: characterization by FTIR and HPLC and comparison with conventional solvent extraction. Vibrational Spectroscopy, 113, 2021. https://doi.org/10.1016/j.vibspec.2020.103204

[22] E. Horuz, H. Bozkurt, H. Karataş, M. Maskan, Comparison of quality, bioactive compounds, textural and sensorial properties of hybrid and convection-dried apricots. Journal of Food Measurement Characterization, 12:243–256. 2018. https://doi.org/10.1007/S11694-017-9635-X/TABLES/6

[23] K.S. Coruk, H. Baltacıoğlu, Determination of the effect of different drying methods on the physicochemical properties of potato powder using multivariate analysis. Turkish Journal of Agriculture - Food Science and Technology, 10(7), 1300–1307, 2022. https://doi.org/10.24925/turjaf.v10i7.1300-1307.524

[24] E. Horuz, H. Bozkurt, H. Karataş, M. Maskan, Effects of hybrid (microwave-convectional) and convectional drying on drying kinetics, total phenolics, antioxidant capacity, vitamin C, color and rehydration capacity of sour cherries. Food Chemistry, 230:295–305. 2017. https://doi.org/10.1016/J.FOODCHEM.2017.03.046

[25] K. Ghafoor, I. A. M. Ahmed, S. Doğu, N. Uslu, G. J. Fadimu, F. Al Juhaimi and M. M. Ozcan, The effect of heating temperature on total phenolic content, antioxidant activity, and phenolic compounds of plum and mahaleb fruits. International Journal of Food Engineering, 15(11-12), 20170302, 2019. https://doi.org/10.1515/ijfe-2017-0302

[26] R. P. Guiné, M. J. Barroca, F. J. Gonçalves, M. Alves, S. Oliveira and P. M. Correia, Effect of drying on total phenolic compounds, antioxidant activity, and kinetics decay in pears. International Journal of Fruit Science,

15(2), 173-186, 2015. https://doi.org/10.1080/15538362.2015.1017073
[27] Q. Ma, J. Bi, J. Yi, X. Wu, X. Li and Y. Zhao, Stability of phenolic compounds and drying characteristics of apple peel as affected by three drying treatments. Food Science and Human Wellness, 10(2), 174-182, 2021. https://doi.org/10.1016/j.fshw.2021.02.006
[28] H.W. Xiao, Z. Pan, L. Z. Deng, H. M. El-Mashad, X. H. Yang, A. S. Mujumdar, Z.J. Gaoand, Q. Zhang, Recent developments and trends in thermal blanching–A comprehensive review. Information Processing in Agriculture, 4(2), 101- 127, 2017. https://doi.org/10.1016/j.inpa.2017.02.001
[29] A. Sarkar, S. Rahman, M. Roy, M. Alam, M. A. Hossain and T. Ahmed, Impact of blanching pretreatment on physicochemical properties, and drying characteristics of cabbage (Brassica oleracea). Food Research, 5(2), 393-400, 2021. https://doi.org/10.26656/fr.2017.5(2).556
[30] S. C. Santos, G. A. Fortes, L. T. Camargo, A. J. Camargo and P. H. Ferri, Antioxidant effects of polyphenolic compounds and structure-activity relationship predicted by multivariate regression tree. LWT, 137, 110366, 2021. https://doi.org/10.1016/j.lwt.2020.110366
[31] K. Papoutsis, P. Pristijono, J. B. Golding, C. E. Stathopoulos, M. C. Bowyer, C. J. Scarlett and Q. V. Vuong, Effect of vacuum-drying, hot air-drying and freeze-drying on polyphenols and antioxidant capacity of lemon (Citrus limon) pomace aqueous extracts. International Journal of Food Science & Technology, 52(4), 880-887 2017. https://doi.org/10.1111/ijfs.13351
[32] N. Trancoso-Reyes, L.A. Ochoa-Martinez, L.A. Bello-Perez, J. Morales-Castro, R. Estevez-Santiago and B. Olmedilla-Alonso, Effect of pre-treatment on physicochemical and structural properties, and the bioaccessibility of β-carotene in sweet potato flour. Food Chemistry, 200, 199-205, 2016. https://doi.org/10.1016/j.foodchem.2016.01.047
[33] Y. Liu, Y. Liu, C. Tao, M. Liu, Y. Pan and Z. Lv, Effect of temperature and pH on stability of anthocyanin obtained from blueberry. Journal of Food Measurement and Characterization, 12, 1744-1753, 2018. https://doi.org/10.1007/s11694-018-9789-1
[34] M. T. Afolabi, A. G. Black and T. K. Adekunbi, The influence of drying on the physical properties of sweet potato slices. Agricultural Engineering International: CIGR Journal, 18(1), 301-313, 2016.
[35] I. Doymaz, Drying Behavior and Some Quality Parameters of Potato Finger Chips Using Infrared Radiation. Latin American Applied Research-An international journal, 51(4), 261-267, 2021. https://doi.org/10.52292/j.laar.2021.779
[36] S. S. J. Senevirathna, N. S. Ramli, E. M. Azman, N. H. Juhari and R. Karim, Optimization of the drum drying parameters and citric acid level to produce purple sweet potato (Ipomoea batatas L.) powder using response surface methodology. Foods, 10(6), 1378, 2021. https://doi.org/10.3390/foods10061378
[37] H. Baltacıoğlu and K. S. Coruk, Determination of conformational changes of polyphenol oxidase and peroxidase in peach juice during mild heat treatment using FTIR spectroscopy coupled with chemometrics. International Journal of Food Science & Technology, 56(6), 2915-2925, 2021. https://doi.org/10.1111/ijfs.14930
[38] K. Ruttarattanamongkol, S. Chittrakorn, M. Weerawatanakorn and N. Dangpium, Effect of drying conditions on properties, pigments and antioxidant activity retentions of pretreated orange and purple-fleshed sweet potato flours. Journal of Food Science and Technology, 53, 1811-1822, 2016. https://doi.org/10.1007/s13197-015-2086-7
[39] E. Savas, The modelling of convective drying variables' effects on the functional properties of sliced sweet potatoes. Foods, 11(5), 7K, 2022. https://doi.org/10.3390/foods11050741