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Several Parameters Influencing to the Production of Avocado (*Persea americand*) Powder

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Abstract.
Avocado (*Persea americand*) provides the healthy kind of fat that our body need. Oleic acid is the primary fatty acid in avocados. Avocado is rich in omega-3. It is an excellent source of carotenoids so it's great for vision. It also contains dietary fiber, essential nutrients and phytochemicals. However it is a highly perishable fruit. Substantial amount of fruit is lost due to poor post-harvest practices and seasonal nature of the product. Objective of the present study focused on the effect of temperature and time, citric acid concentration in blanching; time in steaming; carrier concentration in drying to antioxidant activity of avocado powder; shelf-life of avocado powder in accelerated temperature. Optimal results found that avocado pulp should be blanched at 80°C in 4 minutes with the present of 0.06% citric acid; steaming at 100°C in 4 minutes; maltodextrin: avocado at ratio 1.5: 1.0; drying at 60°C with 30% gelatin: 70% maltodextrin as carrier; sample be packed and stored below 45°C in vaccum in two layes PA/PE with alluminum carton layer outside.

Keywords: *Avocado, powder, blanching, steaming, carrier, shelf-life*

I. INTRODUCTION

Avocado (*Persea americand*) is a pear shaped drupe of olive green colour. The skin is smooth to coarse, and the colour can vary from green-yellow, reddish-purple, purple, or black. The pulp of ripe avocado is creamy and pale green. It's considered as a super food due to their high nutritional values and multiple benefits for the health of the human beings. Avocado is high in mono-unsaturated fats and calories. It's a powerhouse of heart-healthy fats and brain-boosting omega fatty acids. Oxidation of avocado oil in pulp can lead to the formation of volatile compounds responsible for off-flavors and to nutritional losses (Prabath Pathirana et al., 2013). It's very rich in dietary fiber, vitamins, and minerals and packed with numerous health benefiting plant nutrients. Avocado fruit ripening is the processes resulting in changes in colour, taste and texture, which make the avocado acceptable for consumption. High levels of the amino acid homocysteine are associated with a higher risk of heart disease, but the vitamin B6 and the folic acid found in avocados can help regulate it so it's healthy for the heart. It contains lutein and zeaxanthin, two phytochemicals that are essential to eye health. Vitamin K in avocado can improve bone health by increasing calcium absorption and reducing urinary excretion of calcium. Low intakes of vitamin K have been associated with a higher risk of bone fracture. It contains folatewhich have a suppressing effect on cancer cells. Satisfactory intake of dietary folate has also shown potential in protecting against colon, stomach, pancreatic and cervical cancers. Folate helps produce and maintain new cell. Its high fiber content can prevent constipation, encourage regular bowel movements, helps in natural detoxification by daily excretion of toxins through the bile and stool, maintain a healthy digestive tract, contribute to weight loss by providing a feeling of fullness, reduce blood sugar spikes and lower the risk of colon cancer (Victor L Fulgoni et al., 2013). Avocado contains a high amount of potassium, even more than bananas. This nutrient helps maintain electrical gradients in the body's cells and serves various important functions. Having a high potassium intake is linked to reduced blood pressure by regulating the effects of salt, a major risk factor for heart attacks, strokes and kidney failure. Avocado has high levels of monounsaturated fats which can help stop insulin resistance, which helps to regulate blood sugar levels. The soluble fiber in avocado can help keep blood sugar levels steady (Patrícia Fonseca Duarte et al., 2016). The low carb and sugar levels in avocado also help maintain blood sugar. Glutathione, which can be found in avocado, is a powerful antioxidant associated with immune system health. The vitamin C and vitamin E in avocado help keep skin nourished and glowing. Avocado and B12 cream may be useful in treating psoriasis, a condition in which skin cells build up and form scales and itchy, dry patches. Avocado contains a variety of minerals. Magnesium is essential for bone strengthening and has a cardiac-protective role as well. Manganese is used by the body as a co-factor for the antioxidant enzyme, superoxide dismutase. Iron and copper are required in the production of red blood cells. Iron carries oxygen throughout your body so cells can produce energy (Kevin B. Comerford et al., 2016).

It is a highly perishable fruit. There was an increase in Brix degrees (5.07 to 7.26) and pH (6.58 to 7.14) throughout the storage time until the fourth week, where these decreased. In contrast, acidity dropped (19.47 to 9.24 %) with storage time (Camilo Ernesto Astudillo-Ordóñez, Pablo Rodríguez, 2018). Avocado can be consumed as fresh fruit (Prabath Pathirana et al., 2013;

Jorge A.Aguirre-Joya et al., 2017) or processed products such as purre (Robert C.Soliva-Fortuny et al., 2004; R.Quevedo et al., 2015), paste (A. Grajales-Lagunes et al., 1999; H.D. Mepba et al., 2008), powder (Lagunes et al.,1999; Bae K, Lee S, 2008; Alejandra Marulanda et al., 2018).

Spray drying is one of the most common methods in the industrial processing of a wide variety of food products in which a liquid feed is sprayed and transformed into a powder. This technology has been used in the dehydration of fruits and carbohydrate-rich compounds, which have obtained powders with favorable properties in terms of water activity, solubility, hygroscopicity, glass transition temperature, nutrient composition (Chen X, Patel C, 2008; Ferrari C et al., 2012; Krishnaiah D et al., 2015; Santhalakshmy S et al., 2015; Suzihaque M et al., 2015; Paim D et al., 2016; Rezaul M et al., 2017). Spray drying for avocados has had little exploration, due to its high oil composition and physiological characteristics of the fruit (Bae K, Lee S, 2008).

There are plenty of studies mentioned to production of avocado powder. Lagunes et al., (1999) evaluated a fixed operating condition, the effect of mixtures of some antioxidants (BHA, BHT, TBQH, citric acid, ascorbic acid and propyl gallate) on the stability and sensory quality of avocado powder. Research found that TBQH mixture of citric acid had less developed rancidity during storage. The micro-encapsulation of avocado oil has been applied to reduce lipid oxidation using mixtures of whey protein and maltodextrin (MD) (90:10 ratios, 50:50 and 10:90), and input and output temperatures of air 180 and 80°C. Respectively, this allowed counteracted oxidation of the powder during storage for 8 weeks at room temperature, and additionally, improved wetting and density of the powder (Bae K, Lee S, 2008).

Isabelle Santana et al., (2015) studied the influence of drying and extraction on the quality of Hass avocado oil.

Alejandra Marulanda et al., (2018) optimized the spray drying process for obtaining avocado powder with better physicochemical properties and processing. Optimized value factors were: maltodextrin 6.93%, air inlet temperature 160°C, outlet air temperature 84°C and atomizer disk speed 26000 rpm.

Objective of the present study focused on the effect of temperature and time, citric acid concentration in blanching; time in steaming; carrier concentration in drying to antioxidant activity of avocado powder; shelf-life of avocado powder in accelerated temperature.s

II. MATERIALS AND METHOD

2.1 Material

We collected avocado fruits in Central Highland, Vietnam. They must be cultivated following VietGAP to ensure food safety. After harvesting, they must be conveyed to laboratory within 8 hours for experiments. Fruits were washed thoroughly under turbulent washing to remove dirt, dust and adhered unwanted material. Besides avocado we also used other materials during the research such as maltodextrin, gelatin, citric acid. Maltodextrin is originally provied from Germany. Using maltodextrin having high DE will increase moisture and energy iin drying as well as bad encapsulation appearance. In this study we choose maltodextrin having DE = 10. Lab utensils and equipments included digital balance, heat pump dryer, refrigerator, HPLC-AOCS.

Figure 1. Avocado (*Persea americand)* fruit

2.2 Researching procedure

2.2.1 Effect of temperature and time in blanching to antioxidant activity of avocado powder

Experimental parameter:

- Temperature, time of blanching: 70^{o}C, 80^{o}C, 90^{o}C in 2 minutes, 4 minutes, 6 minutes.
- Control sample: Avocado pulp without treatment.

Fixed parameter:

- Avocado pulp after being blanched will be preserved in refrigerator at 5^{o}C, in 15 minutes.
- Weight of sample: 35g fresh avocado pulp
- Scatter sample in drying: 0,2g/cm^2.
- Temperature of drying: 60^{o}C.
- Moisture content of sample after being dryed: 6 ± 1%

Target parameter:

-Antioxidant activity (tocopherol content, mg/100g) of avocado powder

2.2.2 Effect of citric concentration in blaching solution to antioxidant activity of avocado powder

Experimental parameter:

- Acid citric concentration in blanching solution: 0.02%, 0.04%, 0.06%, 0.08%.
- Control sample: Avocado pulp will be blanched at the approriate temperature and time derived from the previous experiment.

Fixed parameter:

- Temperature and time of blanching are selected from the previous experiment.
- Avocado pulp after being blanched will be preserved in refrigerator at 5^{o}C, in 15 minutes.
- Weight of sample: 35g fresh avocado pulp.
- Scatter sample in drying: 0,2g/cm^2.
- Temperature of drying: 60^{o}C.
- Moisture content of sample after being dryed: 6 ± 1%

Target parameter:

-Antioxidant activity (tocopherol content, mg/100g) of avocado powder

2.2.3 Effect of time in steaming to antioxidant activity of avocado powder

Experimental parameter:

- Time of steaming: 2 minutes, 4 minutes, 6 minutes.
- Control sample: Avocado pulp without treatment.

Fixed parameter:

- Temperature of steaming: 100^{o}C.

- Thickness of sample: 5-7mm.
- Temperature of avocado sample in steaming: 95-97^oC.
- Avocado pulp after being steamed will be preserved in refrigerator at 5^oC, in 15 minutes.
- Weight of sample: 35g fresh avocado pulp
- Scatter sample in drying: 0,2g/cm^2.
- Temperature of drying: 60^oC.
- Moisture content of sample after being dryed: 6 ± 1%.

Target parameter:

-Antioxidant activity (tocopherol content, mg/100g) of avocado powder

2.2.4 Comparison of pretreatment methods to antioxidant activity of avocado powder

Experimental parameter:

- Compare the different value between blanching in acid citric solution and steaming.
- Control sample: Avocado pulp without treatment.

Fixed parameter:

- Temperature of steaming: 100^oC.
- Thickness of sample: 5-7 mm.
- Temperature of avocado sample in steaming: 95-97^oC.
- Avocado pulp after pretreatments will be preserved in refrigerator at 5^oC, in 15 minutes.
- Weight of sample: 35g fresh avocado pulp
- Scatter sample in drying: 0,2g/cm^2.
- Temperature of drying: 60^oC.
- Moisture content of sample after being dryed: 6 ± 1%

Target parameter:

- Antioxidant activity (tocopherol content, mg/100g) of avocado powder

2.2.5 Effect of maltodextrin concentration in drying to antioxidant activity of avocado powder

Experimental parameter:

- Ratio of maltodextrin/ avocado dry matter: 0/1; 0.5/1; 1/1; 1.5/1; 2/1 (w/w).
- Control sample: Avocado pulp collected from ultrasonic (without carrier)

Fixed parameter:

- Maltodextrin solution 50% weighed and supplemented into raw material powder in equivalent ratio.
- Avocado pulp after being pretreated in preserved in refrigerator 5^0C, 15 minutes.
- Sample weigth: 35 g raw avocado.
- Scatter sample in drying: 0.2 g/cm^2.
- Temperature of drying: 60^oC.
- Moisture content of sample after being dryed: 6 ± 1%.

Target parameter:

- Antioxidant activity (tocopherol content, mg/100g) of avocado powder

2.2.6 Effect of maltodextrin: gelatin concentration in drying to antioxidant activity of avocado powder

Experimental parameter:

- Ratio of maltodextrin-gelatin: based on result of the last experiment, varied gelatin concentration 10%, 20%, 30%, 40%, 50% to volume of maltextrin, and reduce volume of maltodextrin in equivalent to gelatin suplemented (dry matter).
- Control sample: Avocado pulp treated with method from the last experiment.

Fixed parameter:

- Solution 50% carrier (maltodextrin- gelatin) is weighed and added into raw material in equivalent ratio.
- Avocado pulp after being pretreated in preserved in refrigerator 5^oC, 15 minutes.
- Sample weigth: 35 g raw avocado pulp.
- Scatter sample in drying: 0.2 g/cm^2.
- Temperature of drying: 60^oC.
- Moisture content of sample after being dryed: 6 ± 1%.

Target parameter:

-Antioxidant activity (tocopherol content, mg/100g) of avocado powder

2.2.7 Storage of avocado powder in accelerated temperature

Experimental parameter:

- Rancidity (peroxide value) at begining, after 1 days, 2 days etc until carotene reduction > 80% compared to begining at 45 ^oC, 55 ^oC to calculate the real time of preservation.

Fixed parameter:

- Temperature storage: 55 ^oC, 45 ^oC.
- Packing: sample should be packed in vaccum in two layes PA/PE with alluminum carton layer outside.

Target parameter:

- Antioxidant activity (tocopherol content, mg/100g) of avocado powder.

2.3 Physico-chemical and biological analysis

The chemical compositions including protein (g/100g), lipid (g/100g), tocopherol (mg/100g), and moisture content (%) in fresh avocado pulp were analyzed. Protein (by Kjeldahll), lipid (by Soxhlet) and moisture (drying to constant weight) were applied. Tocopherol analysis would be performed by HPLC-AOCS.

2.4 Statistical analysis

The experiments were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT). Statistical analysis was performed by the Statgraphics Centurion XVI.

III. RESULT & DISCUSSION

3.1 Chemical compositions in fresh avocado pulp

The chemical compositions in fresh avocado pulp were analyzed.

Avocado (*Persea americand*) has a high nutritional value, since it is rich in proteins (1.11 to 1.75 g.100 g–1), lipids (4.8 to 10.15 g.100 g–1), and carbohydrates (7.3 to 11.54 g.100 g–1). It also has bioactive substances such as carotenoids (1.72 to 5.65 mg.mL–1), which are fat-soluble substances (Edinéia Dotti Mooz et al., 2012).

3.2 Effect of temperature and time in blanching to antioxidant activity of avocado powder

35g fresh avocado pulp was blanched at 70^oC, 80^oC, 90^oC in 6 minutes, 4 minutes, 2 minutes. Antioxidant activity (tocopherol content, mg/100g) of avocado powder was noted in table 2. From table 2, the optimal condition in blanching of avocado pulp should be conducted at 80^oC, 4 minutes.

Table 1. The chemical compositions in fresh avocado pulp

Parameter	Protein (g/100g)	Lipid (g/100g)	Tocopherol (mg/100g)	Moisture (%)
Value	1.66±0.02	9.14±0.01	43.12±0.00	76.29±0.01

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 2. Effect of temperature and time in blanching to antioxidant activity of avocado powder

Blanching time and temperature	70°C, 6 minutes	80°C, 4 minutes	90°C, 2 minutes
Tocopherol (mg/100g)	37.84±0.02[c]	**41.04±0.01[a]**	39.19±0.00[b]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 3. Effect of citric concentration in blanching solution to antioxidant activity of avocado powder

Citric acid (%)	0.02	0.04	0.06	0.08
Tocopherol (mg/100g)	41.04±0.01[b]	41.28±0.03[ab]	**41.37±0.01[a]**	41.40±0.01[a]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 4. Effect of steaming time to antioxidant activity of avocado powder

Steaming time (minutes)	2	4	6
Tocopherol (mg/100g)	41.37±0.00[b]	**41.68±0.02[ab]**	41.70±0.01[a]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 5. Effectiveness of pretreatment methods to antioxidant activity of avocado powder

Pretreatment method	Blanching 0.06% citric acid, 80°C, 4 minutes	Steaming 100°C, 4 minutes
Tocopherol (mg/100g)	**38.75±0.01[b]**	**41.68±0.02[a]**

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Microwaves technologies have also emerged for blanching to avoid browning of avocado pulps (Guzmán-Gerónimo et al., 2008), presumably by inactivating browning enzymes, and offer advantages such as reduced processing time and time-controlled processes (Jiménez, M. E. et al., 2001)

3.3 Effect of citric concentration in blanching solution to antioxidant activity of avocado powder

35g fresh avocado pulp was blanched at 80°C in 4 minutes with the presence of difference citric concentrations 0.02%, 0.04%, 0.06%, 0.08%. Antioxidant activity (tocopherol content, mg/100g) of avocado powder was noted in table 3. From table 3, citric acid had significantly affected to antioxidant activity of avocado powder. The blanching should be performed with the presence of 0.06% citric acid.

Postharvest pressure infiltration of $CaCl_2$ extended the storage life and slowed down the ripening process of avocado. Ripening of fruits was delayed for 2-3 days with pressure infiltration of $CaCl_2$ compared with untreated fruits, while treated fruits maintained considerable quantity of ascorbic acid at ripened stage. Sensory evaluation revealed that there were no significant differences among treatments for sweetness, color, odor and hardness of fruits (W. R. K. D. W. K. V. Wickramasinghe et al., 2013). Okra could be achieved by blanching with calcium chloride solution at 0.5% w/v for 90 sec to improve the hardness and crispness value, color (CIELab), moisture and fat content, including sensory qualities (AumapornArlai et al., 2014).

3.4 Effect of steaming time to antioxidant activity of avocado powder

Avocado pulp was steamed in different time: 2 minutes, 4 minutes, 6 minutes. Antioxidant activity (tocopherol content, mg/100g) of avocado powder was recorded in table 4. From table 4, the steaming time should be conducted at 4 minutes.

A decline of polyphenoloxidase activity in avocado pulp (*Persea americana* Mill.) was observed in all of the varieties when both, temperature and time increased (Lucimara Salvat Vanini et al., 2010).

3.5 Comparison of pretreatment methods to antioxidant activity of avocado powder

Effectiveness of blanching in 0.06% citric acid at 80°C in 4 minutes with steaming at 100°C in 4 minutes was compared by antioxidant activity (tocopherol content, mg/100g) of avocado powder. Results were elaborated in table 5. From table 5, the pretreatment which was conducted by steaming at 100°C in 4 minutes had a better antioxidant activity than the pretreatment by blanching with 0.06% citric acid at 80°C in 4 minutes.

Nurhuda, H.H. et al., (2013) showed that both water and steam blanchings signifcantly reduced ($p < 0.05$) polyphenoloxidase and peroxidase activities. The results also indicated that the increase in the blanching period did not signifcantly reduce the enzyme activities further. In terms of antioxidant activity, the thermal pretreatment caused no signifcant difference in the contents of phenolic compounds, as well as the antioxidant capacity of the fnal product.

3.6 Effect of maltodextrin concentration in drying to antioxidant activity of avocado powder

Different ratios of maltodextrin/ avocado dry matter: 0/1; 0.5/1; 1/1; 1.5/1; 2/1 (w/w) were examined to demonstrate the effectiveness of maltodextrin concentration in drying to antioxidant activity of avocado powder. Results were elaborated in table 6. From table 6, the optimal ratio of maltodextrin: avocado should be 1.5:1.0 to maintain the highest antioxidant activity.

Maltodextrin/pectin microparticles were used by spray drying as carrier for nutraceutical extracts. Maltodextrins have multifaceted functions including bulking and film formation properties, binding ability of flavour and fat, reduction of oxygen permeability of wall matrix (Francesca Sansone et al., 2011).

3.7 Effect of maltodextrin: gelatin concentration in drying to antioxidant activity of avocado powder

Different ratios of gelatin concentration 10%, 20%, 30%, 40%, 50% to volume of maltextrin were examined to demonstrate the effectiveness of maltodextrin: gelatin concentration in drying to antioxidant activity of avocado powder. Results were elaborated in table 7. From table 7, the drying should be implemented with 70: 30 (maltodextrin: gelatin) to achieve the highest antioxidant activity of avocado powder.

The maltodextrin does not have influence in the encapsulation efficiency probably due to its lack of emulsification and low film-forming capacity. Generally, in samples formulated with the same maltodextrin content, the encapsulation efficiency increased with the increase in gelatin content.

3.8 Storage of avocado powder in accelerated temperature

Rancidity (peroxide value) at begining, at 1 month interval etc until carotene reduction > 80% was compared to begining at 45 ^{o}C, 55 ^{o}C to calculate the real time of preservation. Antioxidant activity (tocopherol content, mg/100g) of avocado powder was used to determine the storage of avocado powder in accelerated temperature. Preservation under 45^{o}C could maintain the antioxidant activity with utmost level.

Avocado (Persea americand) paste was spray dried at inlet air temperature of 180°C, 80°C outlet air temperature, air velocity of 27 m/s and a feed flow rate of 0.642 l/min. Lipids in the paste were emulsified using 10 % Monoacylglyceride (MAG). Treatments were applied according to the following antioxidants mixtures: 1) BHA (butylated hydroxyanisole) + BHT (butylated hydroxytoluene) (0.05 % each); 2) TBHQ (Tertiary butylated hydroxyquinone) + Citric Acid (0.05 + 0.1 %); 3) BHA + BHT + Citric Acid (0.05 + 0.05 + 0.1 %); 4) BHA + Propyl gallate (0.05 + 0.05 %); or 5) BHA + Propyl gallate + Citric acid (0.05 + 0.05 + 0.1 %). Samples were stored at 6, 12, 25, 28 and 40 °C. Peroxide values were determined periodically. Development of rancidity was detected by sensory evaluation of the samples. For samples kept at 6 and 12 °C, an antioxidant mixture containing BHA and propyl gallate at 0.05% gave the least protection to the stored avocado powder. The mixture containing TBHQ and citric acid yielded the lowest rancidity development (Alicia Grajales et al., 1999).

Table 6. Effect of maltodextrin concentration in drying to antioxidant activity of avocado powder

Maltodextrin: avocado	**0:1**	**0.5: 1.0**	**1.0: 1.0**	**1.5: 1.0**	**2.0: 1.0**
Tocopherol (mg/100g)	36.13±0.02^{c}	38.45±0.01^{bc}	39.23±0.02^{b}	41.55±0.00^{a}	**41.60±0.01^{a}**

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 7. Effect of maltodextrin: gelatin concentration in drying to antioxidant activity of avocado powder

Maltodextrin: gelatin	**90: 10**	**80: 20**	**70: 30**	**60: 40**	**50: 50**
Tocopherol (mg/100g)	40.19±0.01^{b}	40.43±0.02^{b}	**41.69±0.00^{a}**	**41.72±0.01^{a}**	**41.73±0.00^{a}**

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 8. Antioxidant activity (tocopherol content, mg/100g) of avocado powder in accelerated temperature

Preservation time (month)	**Storage temperature 45^{o}C**	**Storage temperature 55^{o}C**
0	41.69±0.00^{a}	41.69±0.00^{a}
1	41.52±0.01^{ab}	41.50±0.02^{ab}
2	41.49±0.03^{b}	41.42±0.02^{b}
3	41.34±0.02^{bc}	41.28±0.01^{bc}
4	41.21±0.02^{c}	41.17±0.03^{c}
5	41.11±0.03^{cd}	41.02±0.02^{cd}
6	41.02±0.01^{d}	40.75±0.01^{d}
7	40.48±0.02^{de}	40.23±0.03^{de}
8	40.32±0.02^{e}	40.14±0.03^{e}
9	40.19±0.01^{ef}	40.00±0.02^{ef}
10	40.02±0.03^{f}	39.84±0.01^{f}
11	39.74±0.03^{fg}	39.47±0.02^{fg}
12	39.54±0.02^{g}	39.30±0.01^{g}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

IV. Conclusion

Avocado is considered one of the main tropical fruits, as it contains fat-soluble vitamins, besides high levels of protein, potassium and unsaturated fatty acids. Avocado pulp contains variable oil content, and is widely used in the pharmaceutical and cosmetics industry. This fruit has been recognized for its health benefts such as omega fatty acids, phytosterols, tocopherols and squalene. Avocado is a perishable product, very attractive in the world market due to its high content of unsaturated fatty acids. The spray drying is an alternative conservation for avocado, a highly perishable fruit. The processed avocado pulp is an alternative to utilize fruits, which can be used in various value-added food products. We have successfully optimized the effectivness of temperature and time, citric acid concentration in blanching; time in steaming; carrier concentration in drying to antioxidant activity of avocado powder; shelf-life of avocado powder in accelerated temperature.

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