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Study on Preservation of Selected Vegetables by Various Drying Methods

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Abstract

Drying is one of the oldest and easiest methods of food preservation. Drying is the process of removing water or moisture from a food product. Removing moisture from foods makes them smaller and lighter. This research work was carried out on the drying of selected vegetables (radish, carrot and potato) by different drying methods namely sun-drying (30°C-35°C), air-dryer drying (45°C) and oven-drying (55°C and 65 °C). The effects of drying time and drying temperature on moisture content were determined. The basic parameters such as moisture content of dried products, appearances, rehydration time, storage-life, yield percent and nutritional value were also determined. In this research, the selected vegetables were also preserved by using different amounts of preservative (potassium metabisulphite) and also the characteristics were determined. It was found that there was no lost in nutritional value and also there was no harmful microorganisms. Among three drying methods , oven-drying at 65°C was the most suitable condition due to shorter drying time. It was found that four hour of drying time gave suitable appearance and uniform colour. Moreover, drying product samples by using sun drying, air- dryer drying and oven drying were acceptable ranges for consumer under safety condition. About 0.1% of potassium metabisulphite was the most suitable amount for preservation of radish and carrot and 0.15% was for potato. The shelf-lives of the dried products was one year.

Key Words- Drying Temperature, Drying Time, Moisture Content, Shelf-life

Introduction

The technique of drying is the oldest method of food preservation practised by mankind.The main purpose of drying is to preserve foods by removing the water that is needed for microbial growth and enzyme activity. The removal of moisture prevents the growth and reproduction of micro-organisms causing decay and minimises many of the moisture mediated deterioration reactions. It also reduceds the weight and bulk of foods for cheaper transport and storage. Dried foods can have poorer nutritional and eating qualities than the corresponding fresh foods so the correct design and operation of dryersis therefore needed to minimize changes to the food (Dauthy. M.E., 1995).

Several types of dryers and drying methods, each better suited for particular situtation, are commercially used to remove moisture from a wide variety of food products including fruits and vegetables. While sun drying of fruit is still practised for certain fruit such as prunes, figs, apricots, grapes

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and dates, atmospheric dehydration processes are used for apples and several vegetables. Spray drying is suitable for fruit juice concentrates and vacuum dehydration processes are useful for low moisture/ high sugar fruits like peaches, pears and apricots (Dauthy. M.E., 1995).

Sun-drying is traditionally carried out in places where in an average year the climate allows foods to be dried and stored without the risk of them becoming moist and spoiled. If drying is not traditionally done in an area it is usually because the climate is not suitable and the food does not dry fast enough to prevent spoilage. If drying is to be introduced to such areas it is necessary to use either solar or artifical dryers to assist the drying process, and also to package the dried food for storage (Dauthy. M.E., 1995).

Drying is carried out using hot air or, less commonly, hot metal pans. During drying, water is removed quickly from the surface of food by evaporation. Water from the inside of food then moves slowly to the surface and evaporates. The speed at which water evaporates from the surfaces depends mostly on the properties of drying air. For effective drying, air should be hot, dry and moving. Hot, dry air must be blown over foods so that it can pick up water from the surface of the food and removed it. Faster moving air carries moisture away from the food more quickly than slow moving or stationary air. The speed can be increased by using fans by heating the air to set up convection currents (Rozis, J.F., 1997).

The objectives of the research work are to preserve the vegetables by various drying methods , to determine the most suitable drying condition and to measure the characteristics of dried products.

Materials and Methods

Raw Materials

Selected vegetables such as radish, carrot and potato were obtained from local market. Potassium metabisulphite used for preservation of vegetables was obtained from Kemiko chemical shop, Pabedan Township, Yangon Region.

Methods

The sound and good quality vegetables (radish, carrot, potato) were selected for drying and firstly, the selected vegetables were washed with water in order to remove dirt. Then, the vegetables were peeled off and removed unwanted parts. The cleaned vegetables were sliced into (0.1cm

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thick) slices. The prepared vegetables slices were soaked in boiling water for about five minutes and then soaked again in cool water containing (0.1%) of potassium metabisulphite. The resulting vegetables slices were placed on plastic sieves in order to remove water.

50 g of selected vegetables were placed on a previously weighed stainless steel trays and placed them in an oven. The vegetables were dried at selected temperature (65 °C) for four hours. During drying, moisture contents were measured at every one hour interval and recorded. The resulting dried vegetables were cooled in the desiccators and then packed with plastic bags.

The selected vegetables for sun drying and air-dryer drying were carried out with the same procedure as mention above and the moisture contents were also measured and recorded.

Effect of Drying Time

Effect of drying time was carried out at different times (1 hr, 2 hr, 3 hr, 4 hr , 5 hr and 6 hr) for drying and the moisture content was measured at every (1 hour) interval during drying period. The results are shown in Tables (1, 2 and 3).

Effect of Drying Temperature

Effect of drying temperature was carried out at different temperatures (55 °C, 65°C and 75°C) for drying and the moisture content was measured at every (1 hour) interval during drying period. The results are shown in Tables (4, 5 and 6).

Effect of Preservative

Effect of preservative was carried out at different amount of potassium metabisulphite (0.05%, 0.1 %, 0.15 % and 0.2 %) for each drying and the moisture contents were measured at every (1 hour) interval during drying period and the appearance were also recorded during storage time. The results are shown in Tables (7, 8 and 9).

Results and Discussion

Table (1) shows the effect of drying time on the moisture contents of selected dried vegetables (radish, carrot and potato) by sun-drying. It was found that in natural sun drying, drying time of five hours was the most suitable for drying of radish and carrot and six hours for drying of potato due to their moisture contents.

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In Table (2) the effect of drying time on the moisture contents of selected dried vegetables (radish, carrot and potato) by air-dryer drying was measured. It was also found that the most suitable time for drying of radish and carrot was five hours and for potato was six hours because the moisture content around 5.0 to 6.0 was obtained at that condition.

Table (3) represerents the effect of drying time on the moisture contents of selected dried vegetables (radish, carrot and potato) by oven-drying at 65 °C. From the experiments it was observed that the most suitable drying time for radish, carrot and potato was four hours. It was the most suitable drying condition in preservation of selected vegetables.

The conditions in Tables (4, 5 and 6) were the effect of drying temperature on the drying of radish, carrot and potato respectively. From the research, drying temperature 65 °C was the most suitable for drying of vegetables due to the shorter drying time of four hours. The products were soft and moist interior at 55 °C and at 75 °C, because of higher drying temperature, the dried vegetables became crispy and dark in colour.

Tables (7 and 8) show the effect of preservatives on the characteristics of dried radish and carrot respectively. The preservatives content of 0.1 % was the most suitable amount for drying of radish and carrot because the colour of dried radish and carrot were stable and the browning condition was not formed during one year storage life. .

The effect of preservatives on the characteristics dried potato was shown in Table (9) and it was found that 0.15 % of potassium metabisulphite was the most suitable amount because there were no changes in colour of dried products during the storage time of one year.

The characteristics of dried vegetables were determined and shown in Table (10). So, due to the characteristics of dried products and shorter drying time it was found that oven drying at 65 °C was the most suitable method for the preservation of selected vegetables. It was found that the shelf-life of dried vegetables was one year and there were no change in condition during one year storage time.

The experiments were conducted at the Laboratory of the Department of Industrial Chemistry, West Yangon University.

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Table (1) Effect of Drying Time on Moisture Content of Selected Vegetables by Sun Drying

Weight of Raw Materials = 50 g
Drying Temperature = 30-35ºC

Sr. No	Sample	Moisture content on drying at one hour interval of time (% w/w)					
		1 hour	2 hours	3 hours	4 hours	5 hours*	6 hours**
1.	Radish	31.0	29.01	23.03	10.98	6.01	6.01
2.	Carrot	32.2	27.99	24.99	18.02	6.69	6.69
3.	Potato	33.5	27.3	24.7	19.46	10.78	6.5

* the most suitable drying time for radish and carrot
** the most suitable drying time for potato

Table (2) Effect of Drying Time on Moisture Content of Selected Vegetables by Air-dryer Drying

Weight of Raw Materials = 50 g
Drying Temperature = 45ºC

Sr. No	Sample	Moisture contents on drying at 1 hour interval of time (% w/w)					
		1 hour	2 hours	3 hours	4 hours	5 hours*	6 hours**
1.	Radish	36.01	21.8	7.99	6.8	5.6	5.6
2.	Carrot	33.0	29.5	12.08	6.3	5.2	5.2
3.	Potato	36.6	28.01	18.9	8.7	6.4	5.5

*the most suitable drying time for radish and carrot
** the most suitable drying time for potato

Table (3) Effect of Drying Time on Moisture Content of Selected Vegetables by Oven Drying

Weight of Raw Materials = 50 g
Drying Temperature = 65ºC

Sr. No	Sample	Moisture content on drying at 1 hour interval of time (% w/w)					
		1 hour	2 hours	3 hours	4 hours*	5 hours	6 hours
1.	Radish	27.6	20.4	13.2	5.7	5.7	5.7
2.	Carrot	24.8	17.4	12.5	5.8	5.8	5.8
3.	Potato	24.6	17.1	12.7	5.4	5.4	5.4

* the most suitable drying time

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Table (4) Effect of Drying Temperature on Moisture Contents in the Drying of Radish

Weight of Raw Materials = 50 g

Sr. No	Drying Temperature (°C)	Characteristics					
		Moisture Content (% w/w)	Dying Time (hour)	Colour	Texture	Odour	Yield (% w/w)
1.	55	8.9	4	White	Soft and moist interior	Pleasant	26.8
2.	65*	5.7	4	White	Soft and less crispy	Pleasant	26.8
3.	75	3.7	3.5	Brown	Crispy	Burnt odour	26.8

* the most suitable drying temperature

Table (5) Effect of Drying Temperature on Moisture Content in the Drying of Carrot

Weight of Raw Materials = 50 g

Sr. No	Drying Temperature (°C)	Characteristics					
		Moisture Content (% w/w)	Dying Time (hour)	Colour	Texture	Odour	Yield (% w/w)
1.	55	8.7	4	Red	Soft and moist interior	Pleasant	28.2
2.	65*	5.8	4	Red	Soft and less crispy	Pleasant	28.2
3.	75	3.6	3.5	Dark red	Crispy	Burnt odour	28.2

* the most suitable drying temperature

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Table (6) Effect of Drying Temperature on Moisture Content in the Drying of Potato

Weight of Raw Materials = 50 g

Sr. No	Drying Temperature (°C)	Characteristics					
		Moisture Content (% w/w)	Dying Time (hour)	Colour	Texture	Odour	Yield (% w/w)
1.	55	8.8	4	Pale yellow	Soft and moist interior	Pleasant	26.8
2.	65*	5.4	4	Pale yellow	Soft and less crispy	Pleasant	26.8
3.	75	3.7	3.5	Dark yellow	Crispy	Burnt odour	26.8

* the most suitable drying temperature

Table (7) Effect of Preservative on the Characteristics of Dried Radish

Weight of Raw materials = 50 g
Drying Temperature = 65 °C
Drying Time = 4 hours

Sample	Amount of Potassium metabisulphite (% w/w)	Yield (% w/w)	Moisture Content (%w/w)	Colour	Texture	Shelf-life
1	0.05	26.8	5.7	White	Soft and less crispy	One month
2	0.1*	26.8	5.7	White	Soft and less crispy	One year
3	0.15	26.8	5.8	Pale yellow	Soft and less crispy	One year
4	0.2	26.8	5.8	Pale yellow	Soft and less crispy	One year

* the most suitable amount of potassium metabisulphite

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Table (8) Effect of Preservative on the Characteristics of Dried Carrot

Weight of Raw materials = 50 g
Drying Temperature = 65 °C
Drying Time = 4 hours

Sample	Amount of Potassium metabisulphite (% w/w)	Yield (% w/w)	Moisture Content (%w/w)	Colour	Texture	Shelf-life
1	0.05	28.2	5.8	Red	Soft and less crispy	One month
2	0.1*	28.2	5.8	Red	Soft and less crispy	One year
3	0.15	28.2	5.8	Red	Soft and less crispy	One year
4	0.2	28.2	5.8	Red	Soft and less crispy	One year

* the most suitable amount of potassium metabisulphite

Table (9) Effect of Preservative Content on the Characteristics of Dried Potato

Weight of Raw materials = 50 g
Drying Temperature = 65 °C
Drying Time = 4 hours

Sample	Amount of Potassium metabisulphite (% w/w)	Yield (% w/w)	Moisture Content (%w/w)	Colour	Texture	Shelf-life
1	0.05	26.8	5.4	Pale yellow	Soft and less crispy	One month
2	0.1	26.8	5.4	Pale yellow	Soft and less crispy	Three months
3	0.15*	26.8	5.4	Pale yellow	Soft and less crispy	One year
4	0.2	26.8	5.4	Yellow	Soft and less crispy	One year

*the most suitable amount of potassium metabisulphite

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Table (10) Characteristics of Dried Products

Sr. No	Characteristics	Dried Products		
		Radish	Carrot	Potato
1.	Moisture Content (% w/w)	5.7	5.8	5.4
2.	Ash Content (% w/w)	21.8	22.7	22.4
3.	Protein Content (% w/w)	0.64	0.81	1.53
4.	Crude Fiber Content (% w/w)	0.76	1.05	0.38
5.	Rehydration Time (minutes)	5	5	5
6.	Colour	White	Red	Pale yellow
7.	Texture	Soft and less crispy	Soft and less crispy	Soft and less crispy
8.	Odour	Pleasant	Pleasant	Pleasant
9.	Shelf-life (year)	1	1	1

Item No. (3 and 4) were measured at the Laboratory of Department of Small Scale Industries, North Okkalapa , Yangon Region.

Item No. (1, 2 ,5, 6, 7, 8 and 9) were determined at the Laboratory of the Department of Industrial Chemistry, West Yangon University.

Dried Radish

Dried Carrot

Dried Potato

Conclusions

In this research work, three types of drying methods such as sun-drying, air-dryer drying and oven drying were used for the preservation of selected vegetables. The dehydration of vegetables by natural sun drying was relatively slow and it could not cause rapid evaporation of moisture. Since sun drying depends on uncontrolled factors, production of uniform and standard product is not expected by this method. It was found that oven

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drying at 65 °C was the most suitable drying method due to the shorter drying time than sun dying and air-dryer drying. By using the most suitable drying conditions and preservative amount, it was found that the products had acceptable quality in colour, flavor and texture. In this research work, potassium metabisulphite was used to prevent browning action of vegetables and also preserves the products for long storage. Therefore dehydrated vegetables would no doubt be consumed by people during off-seasons and large scale production of drying vegetables would be possible to export due to their high quality and long storage life.

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