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EFFECT OF PROCESSING OPERATIONS ON MOISTURE REDUCTION IN VEGETABLES CHIPS

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Abstract: **The present investigation was carried out to study effect of processing operations on moisture reduction in vegetables chips. The chips of potato, radish, cucumber, turnip and carrot were prepared by the motorized vegetable slicer. Fruit/vegetable once come in contact with slicing blade; get sliced due to sharp blade. The thickness of vegetables slice adjusted by using the clearance and inclination of blade over disc. After slicing, pretreatments were applied to the vegetable's slices, and an untreated sample was used as a control. The study concluded that the lowest moisture was found in carrot chips (4.00-6.80%) after frying in refined oil and followed by in Potato chips (4.36-5.36%) after frying in mustard oil. It is assumed that shelf-life of these chips shall be longer than the others vegetables chips.**

Keywords: **Processing, Operations, Moisture, Vegetable Chips, Pretreatments, Refined Oil.**

I. INTRODUCTION

Fruits and vegetables play an important role in human diet and nutrition. They are indispensable sources of essential dietary nutrients, vitamins and minerals besides providing crude fiber. India is the largest producer of fruits and vegetables next to China. But due to lack of post harvest handling and processing facilities around 30% of the total production is lost every year described by Ajiet al., (2018). Peeling and slicing of the well matured unripe plantain is a difficult operation for an unskilled person and also time consuming. Peeling is the removal of skin from green mature plantain. Slicing is carried out to reduce the size of product so as to enable it to suit the processing and consumer requirements. At present, peeling and slicing of plantain is done manually by stainless steel knives. This conventional method poses danger to operator's finger by inflicting injury. Frying quality of chips depends greatly on the uniformity of the wafers. The existing conventional method does not produce chips of uniform size. The output capacity of the system is less and the whole process is time consuming and labor intensive has been studied by Parwaret al., (2020).

Slicing is a form of size reduction and the general term "size reduction" includes slicing, cutting, crushing, chopping, grinding and milling. The slicing is brought about by mechanical means without change in chemical properties of the material and uniformity in size and shape of individual units of the end product. Such processes as slicing of fruits or vegetables for canning, slicing sweet potatoes for drying, onion slicing for salad, slicing corn fodder, grinding grain for livestock feed and milling flour are size reduction operations. Reducing the size of food raw materials is an important operation to achieve a definite size range. Slicing may help in the extraction of desirable constituents from raw materials easily due to its reduction in size e.g. for making of chips (wafers), crushing fruits for juice or for fermentation. Slicing operation is achieved by cutting, which involves moving, pushing or forcing thin sharp blade or knife through the materials resulting in minimum rupture and deformation of the materials described by Tanwaret al., (2011).

Potatoes are commonly regarded as a bulky, perishable, and a high transport cost commodity with limited export potential, confined mostly to cross-border transactions. Indian potato varieties are medium dry matter varieties having dry matter content between 20-23%.The nutritional composition of potatoes is also very important for processing. Dry matter content of potato varieties ranged from 15.4 to 23.1%. Potato varieties having 23 percent or more dry matter are classified as high dry matter varieties which are suitable for chips manufacture. Based on this classification, All the potato varieties are not suitable for diverse forms of processing. The suitability of a variety for a particular process depends upon the nutritional composition such as the dry matter content, sugars, protein and other nitrogenous compounds.

The turnip (B. rapa ssp. rapa) was one of the most important crops grown over the centuries in Alpine regions. In the study area every farmer grew turnips. For the elderly generation turnips were in high reputation as an everyday vegetable and versatile utilized species with basic foodstuff character. Many essential nutrients are present in the turnip greens which are not present in the turnip roots. Turnip greens are not only abundant in antioxidants such as

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carotenoids, xanthins, lutein, vitamin A and vitamin C, but are also an excellent source of vitamin K.

Radish is grown for its tender tuberous roots which are eaten raw as salad or as cooked vegetable. It has a unique pungent flavour. It is also used in Parathas which are taken with curd for breakfast in north India. It has a cooling effect, prevents constipation and increases appetite and is more nutritious when cooked with leaves. Young leaves are also cooked as vegetable. It is recommended for patients suffering from piles, liver troubles, jaundice etc. Juice of fresh leaves is sued as diuretic and laxative. Radish is a good source of vitamin-C and minerals. Rat-tail radish (R. sativus var. caudatus), which is similar to common radish, is grown for its long slender pods which are used as salad or cooked vegetable. It will not produce fleshy root as in radish.

Cucumber plant can be cultivated in both temperate and tropical environment hence it is said to be a native of many regions of the world. Several varieties of cucumber but the edible cucumber is classified under two groups the slicing and pickling cucumber. It also has several health benefits such as: rehydrating the body, health regulating the blood pressure, body weight management, cholesterol reduction, cancer prevention, bone health, diabetes cure and antioxidant activity.

Carrot (Daucascarota) is one of the most important seasonal root vegetables of Apiaceae (Umbelliferae) family, grown throughout the world and is the most important source of dietary carotenoids (Torronenet al., 1996). It is usually orange, red, purple, white or yellow in color, with a crisp texture when fresh. Carrot is an excellent source of β-carotene, a precursor of vitamin A, which protects cells from free radicals which may damage the basic cell structure of healthy cells (Demiret al., 2004; Yoon et al., 2005). It is also rich source of vitamin C, vitamin B-complex and minerals (Waldeet al., 1992).

The demand for fruit and vegetable chips is supported by shifting inclination towards convenient, functional, and flavored on the go snacks. The demand for fresh fruit and vegetable has increased during the pandemic, which is driving the product adoption and is likely to boost the overall market growth in the coming years.

II. MATERIALS AND METHODS

The present investigation was carried out to study effect of processing operations on moisture reduction in vegetables chips. The chips of potato, radish, cucumber, turnip and carrot were prepared by the motorized vegetable slicer. The work was conducted during 2022in the laboratory developed under the RKVY project on "Agro Processing Centre" in the College of Post Harvest Technology and Food Processing, S.V.P. University of Agriculture & Technology, Meerut. Studies were also carried out to evaluate moisture reduction in different employing processing operations as well as pretreatmentsof potato, radish, cucumber, turnip and carrot chips.

Fresh vegetables were procured from the local market Meerut. Leaves and end portion were removed with a sharp-edged knife, washed with tap water to remove the dust and dirt over the surface. Peeled and again washed with water followed by slicing with a motorized slicer. The chips were then weighed and achieved sliced weight samples were made for each pretreatment and drying and frying achieved as per experimental plan.

The sliced was subjected to pre-treatments indicated as (T_1)Blanching with 0.5% KMS + 0.5 % CA, (T_2) Blanching with 0.5% KMS + 0.5 % CA +1 % NaCl and (T_3)Blanching with 0.5% KMS + 1.0 % NaCl. The slices were then removed from the solution and the surface moisture was removed by blotting paper then after slices were spread in trays subjected to drying in tray dryer at, 65^{0}C. after drying vegetables slices fried in mustard and refined oil.

Determination of Moisture Content: Moisture of fresh sample was obtained by the standard method (AOAC, 1990).100gm sample was weighed in plate and kept in the tray dryer at 60^{o}C till constant weight was achieved. The dried samples were then cooled to room temperature in a desiccator prior to weighing. Loss in weight of sample after drying representing the moisture content was expressed as percent (w/w).

$$\text{M. C. (wb, \%)} = \frac{(\text{Initial weight} - \text{Final weight})}{\text{Initial Weight}} \times 100$$

III. RESULTS AND DISCUSSION

There are various types of the unit operation performed to development of vegetables slices from the different types of vegetables like Potato, cucumber, turnip, radish and carrot. The various operation like cutting, blanching/cooling, drying and frying are affecting the moisture content of the slices. The observation data as above given in Table 1.

Effect of processing operations on moisture content of vegetable chips

Potato Chips

The initial moisture content in fresh cucumber was determined about 82.91 percent. The moisture content was decreased with applying different unit operations like blanching, cooling and drying and frying process to develop the vegetable slices. The effect of the treatment on the moisture content is also observed. It seems that the blanching process is responsible to increase the moisture content in slices. Similar results showed in mushroom drying by (Chandra and Samsher, 2004). Highest moisture was released in drying process done in tray dryer at 60^{0}C temperature. From the Table 1, it seems that the cooling process is also deceased moisture of slices due to osmosis process take place. The osmotic pressure of water in slices is higher as compared to the pure water used for cooling.

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Highest water loss was found in the potato slices treated (T2) with 0.5%KMS + 1%NaCl+0.5%CA just after frying in mustard oil (4.36%). Moisture in potato slices is observed after blanching (78.78 – 85.78%), after cooling (74.00 - 87.75 %), after drying (6.20-7.50%) and after frying (4.36-5.36 in mustard oil) and (5.20-5.75% in refined oil). In case of frying mustard oil is found better than refined oil as per present study. The study revealed that the lowest moisture content was found in mustard oil fried potato chips as compared to refined oil. As per using treatment, the treatment 2 was given best result in mustard frying of potato chips and in case of refined oil, the treatment 3 was found better than other treatments. Residual moisture content in fried potato chips depends on the using various processing operations, initial and consequently moisture content of raw potato chips, texture and types of treatments. The cooling process after blanching was play a vital role to moisture loss in chips preparation.

Table: 1: Effect of Treatments on moisture content (%) of vegetable chips

Sample	Initial	After Blanching	After cooling	After drying	After frying	
					Mustard oil	Refined oil
Potato						
T1	82.91	78.78	74.00	07.50	05.36	05.75
T2	82.91	85.78	87.75	06.50	04.36	05.25
T3	82.91	82.28	78.50	06.20	04.86	05.20
Cucumber						
T1	94.58	88.00	85.00	15.25	08.75	08.85
T2	94.58	90.25	88.00	18.25	07.75	07.26
T3	94.58	94.30	91.67	14.25	06.85	06.30
Turnip						
T1	95.16	94.00	92.00	12.35	07.35	08.25
T2	95.16	92.50	92.50	11.35	06.55	06.00
T3	95.16	93.80	93.60	11.35	06.35	06.20
Radish						
T1	94.25	91.35	86.75	14.75	05.75	07.25
T2	94.25	94.35	94.75	12.75	07.55	07.80
T3	94.25	91.85	94.75	13.75	06.05	05.25
Carrot						
T1	86.19	88.00	88.35	05.75	05.25	06.80
T2	86.19	87.45	86.35	06.70	04.25	05.75
T3	86.19	82.00	85.35	06.75	04.25	04.00

Cucumber Chips

The initial moisture content in fresh potato was determined about 94.58 percent. The moisture content was decreased with applying different unit operations like blanching, cooling and drying and frying process to develop the vegetable slices. The effect of the treatments on the moisture content is also observed. Highest moisture was released in drying process done in tray dryer at 60^0C temperature. From the Table 1, it seems that the cooling process is also deceased moisture of slices due to osmosis process take place. The osmotic pressure of water in slices is higher as compared to the pure water used for cooling. Highest water loss was found in the potato slices treated (T3) with 0.5%KMS + 0.5%NaCl just after frying in refined oil (6.30%). Moisture in cucumber slices is observed after blanching (88.00-94.30 %), after cooling (85.00 -91.67 %), after drying (14.25-18.25%) and after frying (6.85- 8.75% in mustard oil) and (6.30-8.85% in refined oil). In case of frying, refined oil is found better than mustard oil as per present study. The study revealed that the lowest moisture content was found in refined oil fried cucumber chips as compared to mustard oil. As per using treatment, the treatment 3 was given best result in refined oil frying of cucumber chips and in case of mustard oil, the treatment 3 was found better than other treatments. Residual moisture content in fried cucumber chips depends on the using various processing operations, initial and consequently moisture content of raw cucumber chips, texture and types of treatments. The cooling process after blanching was play a vital role to moisture loss in chips preparation.

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Turnip chips
The initial moisture content in fresh turnip was determined about 95.16 percent. The moisture content was decreased with applying different unit operations like blanching, cooling and drying and frying process to develop the vegetable slices. The effect of the treatments on the moisture content is also observed. Highest moisture was released in drying process done in tray dryer at 60^0C temperature. From the Table 1, it seems that the cooling process is also deceased moisture of slices due to osmosis process take place. The osmotic pressure of water in slices is higher as compared to the pure water used for cooling. Highest water loss was found in the turnip slices treated (T3) with 0.5%KMS + 0.5%NaCl just after frying in refined oil (6.35%). Moisture in turnip slices is observed after blanching (92.50-94.00%), after cooling (92.00-93.60%), after drying (11.35-12.35%) and after frying (6.35- 7.35% in mustard oil) and (6.00-8.25% in refined oil). In case of frying, refined oil is found better than mustard oil as per present study. The study revealed that the lowest moisture content was found in refined oil fried turnip chips as compared to mustard oil. As per using treatment, the treatment 3 was given best result in refined oil frying of turnip chips and in case of mustard oil, the treatment 3 was found better than other treatments. Residual moisture content in fried turnip chips depends on the using various processing operations, initial and consequently moisture content of raw turnip chips, texture and types of treatments. The cooling process after blanching was play a vital role to moisture loss in chips preparation.

Radish Chips
The initial moisture content in fresh radish was determined about 94.25 percent. The moisture content was decreased with applying different unit operations like blanching, cooling and drying and frying process to develop the vegetable slices. The effect of the treatments on the moisture content is also observed. Highest moisture was released in drying process done in tray dryer at 60^0C temperature. From the Table 1, it seems that the cooling process is also deceased moisture of slices due to osmosis process take place. The osmotic pressure of water in slices is higher as compared to the pure water used for cooling. Highest water loss was found in the radish slices treated (T3) with 0.5%KMS + 1.0 % NaCl just after frying in refined oil (5.25%). Moisture in radish slices is observed after blanching (91.35-94.35%), after cooling (86.75-94.75%), after drying (12.75-14.75%) and after frying (5.75- 7.55% in mustard oil) and (5.25-7.80 % in refined oil). In case of frying, refined oil is found better than mustard oil as per present study. The study revealed that the lowest moisture content was found in refined oil fried radish chips as compared to mustard oil. As per using treatment, the treatment 3 was given best result in refined oil frying of radish chips and in case of mustard oil, the treatment 3 was found better than other treatments. Residual moisture content in fried radish chips depends on the using various processing operations, initial and consequently moisture content of raw radish chips, texture and types of treatments. The cooling process after blanching was play a vital role to moisture loss in chips preparation.

Carrot chips
The initial moisture content in fresh carrot was determined about 86.19 percent. The moisture content was decreased with applying different unit operations like blanching, cooling and drying and frying process to develop the vegetable slices. The effect of the treatments on the moisture content is also observed. Highest moisture was released in drying process done in tray dryer at 60^0C temperature. From the Table 1, it seems that the cooling process is also deceased moisture of slices due to osmosis process take place. The osmotic pressure of water in slices is higher as compared to the pure water used for cooling. Highest water loss was found in the carrot slices treated (T3) with 0.5%KMS + 1.0 % NaCl just after frying in refined oil (5.25%). Moisture in carrot slices is observed after blanching (82.00-88.00%), after cooling (85.35-88.35%), after drying (5.75-6.75%) and after frying (4.25-5.25% in mustard oil) and (4.00-6.80 % in refined oil). In case of frying, refined oil is found better than mustard oil as per present study. The study revealed that the lowest moisture content was found in refined oil fried carrot chips as compared to mustard oil. As per using treatment, the treatment 3 was given best result in refined oil frying of carrot chips and in case of mustard oil, the treatment 3 was found better than other treatments. Residual moisture content in fried carrot chips depends on the using various processing operations, initial and consequently moisture content of raw radish chips, texture and types of treatments. The cooling process after blanching was play a vital role to moisture loss in chips preparation.

IV. CONCLUSION

Moisture in cucumber slices is observed after blanching (88.00-94.30 %), after cooling (85.00 -91.67 %), after drying (14.25-18.25%) and after frying (6.85- 8.75% in mustard oil) and (6.30-8.85% in refined oil).Moisture in turnip slices is observed after blanching (92.50-94.00%), after cooling (92.00-93.60%), after drying (11.35-12.35%) and after frying (6.35- 7.35% in mustard oil) and (6.00-8.25% in refined oil). In case of frying, refined oil is found better than mustard oil as per present study. The study concluded that the lowest moisture was found in carrot chips (4.00-6.80%) after frying in refined oil and followed by in Potato chips (4.36-5.36%) after frying in mustard oil. It is assumed that shelf-life of these chips shall be longer than the others vegetables chips.

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Conflict of Interest

We, the authors of the article "Effect of Processing Operations on Moisture Reduction in Vegetables Chips" wish to state that there are no conflicts of interests in this our research articles.

V. REFERENCES

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