

Avocado Instant Juice Cube

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Abstract—Fruit juice becomes a demanded product in the modern world. The processing of fresh fruit juice is a huge challenge for the fruit juice industry. Consumers tend to consume fruit juices with the best quality of the fruit; the quality depends on the processing method and process parameters of the fruit juice processing plant. When considering the process parameters; the high-temperature fruit juice processing methods can affect the nutritional quality of the fruit juice. Application of the freeze-drying method to develop this instant juice cube can result in the best quality with the best nutritional components. Instant products obtain high demand in these days. Therefore, the protection of the main components is the main target of this developed product. This product is more useful for modern people who has busy lifestyles. Avocado fruit is highly nutritious fruit with high production. Hence the main focus of this research paper is developing a new product from Avocado fruit to overcome the problems of post-harvest loss and developing the instant product with multi-nutritional value.

Index Terms—Avocado, instant juice, Multi nutritional value.

1 INTRODUCTION

Avocado is one of the popular fruit crops consumed in Sri Lanka which is commonly grown fruit in home gardens of the wet zone of the country. Although first introduction of avocado into Sri Lanka is not well documented, some evidence suggests that it could have been originally domesticated over 200 years ago. However, the first recorded introduction was made on 12th May 1927 during the British occupation of the island [1].

Avocado is a nutritious fruit. One-third of a medium avocado (50g) has 80 calories and contributes nearly 20 vitamins, minerals and phytonutrients, making it a heart-healthy choice to help meet nutrients needs. Moreover, the nutrient facts of avocado are mentioned in the following table (Table 1) [2].

Table 1. The nutritional content of some avocado varieties

Variety	Energy	kJ/kcal	Moisture (g)	Ash (g)	Fat (g)	Protein (g)	Carbohydrates (g)	Total fiber (g)
Pellejo ^a	519/124	77.40	1.10	1.37	1.37	1.37	3.70	3.73
Grande ^a	176/42	88.60	0.50	1.37	1.37	1.37	4.82	2.25
Verde ^a	757/181	72.40	1.10	1.81	1.81	1.81	5.89	0.40
Hass ^b	715/171 ^c	77.30	1.30	1.60	1.60	1.60	5.60	----

^a INNSZ, 1996
^b Ortiz, A., 2003
^c this value was estimated from the nutrient contents.

Avocado is well adapted throughout the wet zone of the low, mid and high country of Sri Lanka. Presently avocado is successfully grown in the districts of Kegalle, Kandy, Mathale and certain areas of Bandarawela and Nuwara Eliya. Gampaha, Colombo and Kurunegala are the other potential areas where avocado could be grown [1]. Present yields are recorded as annual production is around 11,600 tones.

When considering the avocado production, there are very few products available in the market (Avocado oil, avocado spread, and avocado yoghurt). Therefore, there is a significant potential to develop new products from avocado. Avocado can be consumed as a fruit juice or ready to serve drink also, but in local or foreign market

conspicuous avocado product regarding the above sector are limited. So, this attempt to develop an instant avocado juice cube is really important for both local and foreign market due to its feasibility, demand and nutritive value.

2 PROCEDURE

2.1 Plant location

Plant location selection is a very important factor. It is a multi-person and multi-critical decision problem [3]. Selection of plant location depend on some factors. Such as Markets or raw materials, Labor and utility costs, Taxes, politics, Environmental regulations, Incentives offered by communities, states and regions, Distribution practices, infrastructure [4].

When selecting the location, it should be a constant source of avocado [5]. Avocado is successfully grown in the districts of Kegalle, Kandy, Malate and certain areas of Bandarawela and Nuwara Eliya. Other potential areas where avocado could be grown are Gampaha, Colombo and Kurunegala [1].

2.2 Market evaluation

According to market evaluation, there are no processed food products of avocado in Sri Lanka except fresh fruits and fresh avocado juice.

2.2 Process flow diagram

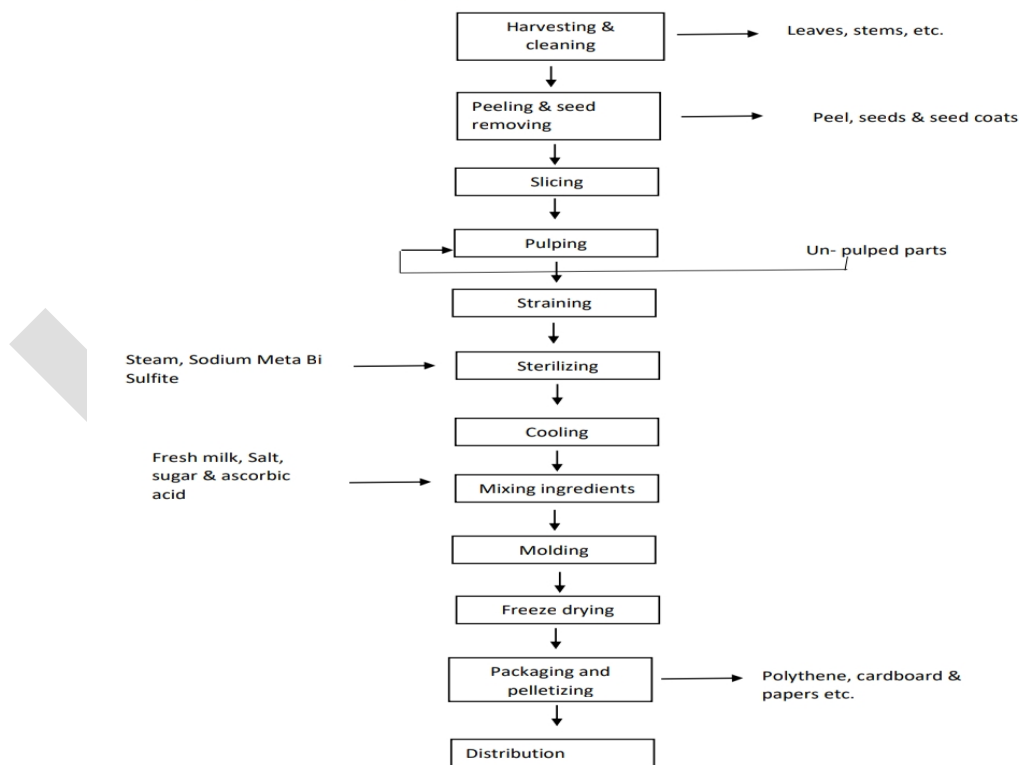


Fig. 1. Avocado instant juice cube process

1. Harvesting: Harvesting of the fruits was carried out during proper maturity stage and using proper harvesting methods to get fruits without any damage to the fruits (manual harvesting or mechanical harvesting). As the fruits get maturity, they develop a smoother skin surface and glossiness or shine of the skin becomes duller as the fruit reaches maturity. With the maturity of avocado, fruit color of many cultivars changes from green to light green.

2. **Transportation:** Transportation of the fruits from field to processing plant was done carefully to reduce the damages during transport.
3. **Weigh the fruits:** After transportation, the weighing of the fruits with the truck was done to get initial raw material weight. Weight of the fruits was measured by reducing the weight of the truck from the weight of the truck and fruits. This weight is important to get the final product yield, estimate the waste production and cost management.
4. **Unloading:** Unloading of the fruits should be done carefully to reduce damages to the fruits. In here the boxes with fruits were manually placed on a transport band which twist them over and transported them to the cleaning brushes.
5. **First cleaning:** In this step, the dry cleaning of the fruits was done. First, the fruits were moved through a perforated band and the stems and leaves were removed. Then fruits were moved through a rotating brush and the dust on the surface was removed. After the damaged fruits and remaining leaves and stems were removed manually.
6. **Ripening and lab analysis:** After dry cleaning, the fruits were allowed to ripening. During ripening Brix value, pH value and acidity were measured. [6]
7. **Sorting and grading:** After ripening, damaged and spoiled fruits were removed and grading of the fruits was done according to the size for easy peeling.
8. **Final cleaning:** Final cleaning was done using chlorine water to reduce the microbial load on the surface of the fruits. And then fruits were washed with normal water.
9. **Blanching:** Blanching was done to reduce the microbial load on the surface to avoid contamination and easy removal of the peel. This process facilitates avoiding the browning reactions during processing steps.
10. **Peeling and seed removing:** After blanching peeling and removing of seeds which are not used for the production was done and they were used as waste to produce compost.
11. **Slicing, pulping and straining:** After peeling, fleshy parts are sliced and pulped to get small particles and straining is done to get the unique size of particles.
12. **Sterilizing and cooling:** Sterilizing is done to destroy the microbial load in the pulp for the extent the shelf life. After sterilizing pulp is again allowed to cool. For the sterilization process Sodium Meta, bi Sulphite (SMS) is added 30g for 100kg of the pulp as preservatives.
13. **Mixing other ingredients:** In this step fresh milk, sugar, ascorbic acid and salt are used as a thickening, flavouring agents and antioxidants. And also they specific taste to the product. And in this step homogenization is done to mix all the ingredients well. In here 200g of sugar, 20g of ascorbic acid, 20g of salt, and 80g of fresh milk is added for 100g of avocado pulp.
14. **Moulding:** After the homogenizing process, the mixture is filled into moulds and freeze drying is done. Freeze drying is the preservation method of this product.
15. **Packaging and pelletizing**

2.4 equipment design

Different types of equipment and machinery are used in the production of the instant avocado juice cube from harvesting of avocado to the formation of the final product. For manufacturing the equipment the materials like

stainless steel, aluminium is used. All the equipment are produced according to the standards to keep sanitary conditions during the production.

1. Hooks and harvesting machine: to harvest the fruits [2]
2. Travelling boxes and truck: to transport harvested fruits into the factory.
3. Digital truck weighing system: to get the weight of the loaded truck and unloaded the truck.
4. Transport band: to twist the fruits from the boxes to the moving system and move them to the further operations
5. Perforated transport band: to remove stems and leaves with the harvested fruits and transport them to the cleaning brushes
6. Rotating brushes with airflow: to clean the fruit surfaces by removing dust and foreign materials.
7. pH meter: to measure the pH of the pulp and the product in different processing steps
8. Brix meter: to measure the Brix value during the processing steps
9. Other lab equipment and glass wears (thermometer, burettes, pipets etc.)
10. Sorting and grading: to select suitable fruits for processing
11. Water bath and motor: to wash the foods
12. Hot water bath: to blanch the fruits
13. Peeling machine: to remove the outer peel
14. Knife: to remove remaining peel and seeds
15. Slicing machine: to get slices of the flesh parts
16. Pulping machine: to get the pulp of the sliced flesh parts
17. Mechanical strainer: to separate un-pulped flesh parts from the pulp
18. Steam jacketed kettle: to sterilize the pulp of avocado
19. Mixing vessel: to mix the pulp with other ingredients
20. Moulding trays: to get the cubes
21. Freeze dryer: to prepare cubes without affecting the sensory properties of fruit
22. Packaging and palletizing system: to pack and palletize the final product

2.5 Packaging

The packaging is a very important factor in fruits and vegetable products whether fresh form as a product. According to this avocado fruit product, the packaging material also has to be considered because this product is "instant fruit product". So the shelf life of this product depends on the packaging material and packaging process conditions in the processing plant. The purpose of this packaging is to preserve the fruit products in good conditions.

Moreover, the selection of the best packaging material for the fruit products is there are some factors to be considered. Such as, it must be non-toxic and compatible with the product, sanitary protection, ease of opening, appearance and printability, low cost [7, 8].

The selection of packaging material for this product is aluminium foil with oil paper. Aluminium foil is an important material in laminates and has a wide application in food packaging. This foil has lots of advantages in product packaging. There are; its barrier function against the migration of moisture, O₂ and volatile aroma. Therefore, aluminium foil is used in the limiting factor for shelf-life stability of food product. Aluminium packaging material considered to be safe, and the inner coating of the foil is recommended in Specific cases [9,10]. The product can be wrapped with this aluminium foil by using an automated packaging machine. Then those each cube are packing in a box as six cubes for one box. Next, those boxes move to the labeling process.

2.6 Labeling and palletizing

After wrapping with aluminium foil these cubes should be labeling. In the labeling process, those boxes are

labeling as “**INSTA AVOCADO JUICY CUBE**”. All the ingredients which added with quantity, nutrients components which obtain this product, tips for preparation, expiry and manufacturing dates etc. labeling also done by automated labeling machines. Then those small boxes are packaging in a cardboard box. One cardboard box per fifty small boxes. Next, these boxes are pelletizing in a pellet. Twenty boxes are pelletizing in five per each side and storage in a storage area and prepare for transportation to the market.

3 WASTE MANAGEMENT IN PROCESSING INSTANT JUICE CUBE

3.1 Waste management in the food industry

Large amounts of food are being wasted throughout the food supply chain; in primary production, during distribution and sale of food products, the preparation and serving of food in commercial and domestic environments. The foodservice sector is one of the most significant areas of food waste. Besides many other actions that can be taken, the simplest and the most preferable practice is the prevention of waste at the source. Food waste is much more costly that is obviously seen as well as its impact is much more serious. When food is wasted all of the natural resources that were expended in the supply chain like land, water and energy are also lost. Except for economic impact, the impact that food waste has on the environment and society is bitterer. Global environmental problems such as pollution and climate change can cause due to broad-scale effects of food wastage. International Organization for Standardization (ISO) has developed a numerous number of international standards which help organizations to improve their management systems and optimize their processes related to quality (ISO 9001), environment (ISO 14001), energy (ISO 50001), and so on [11].

3.2 Waste formed in the processing of avocado

Two main wastes are formed in the processing of the avocado cube. Such as solid and liquid waste. Waste prepared in processing is proportional to the received raw material amount.

Solid waste: Main solid waste formed in the process are peeled, seeds of avocado, rejected fruits, packaging materials removed in raw material receiving area. These wastes can be categorized as Organic waste and Inorganic waste. Each waste is processed to a useful product or discharge in an eco-friendly way.

All organic wastes are used for compost production. Composting is the oldest form of recycling organic matter. Composting is a natural biological process that breakdowns organic material under aerobic conditions into stable compost. During composting, the microorganisms consume oxygen and feeding on organic matter. The microbes utilize carbon and nitrogen as sources of food. As by-products of this process carbon dioxide, water and heat can be considered. The heat generated by the microbes kills off unwanted pathogens, weed seeds and bacteria. When the microbes have used the available carbon and nitrogen they start to decline in numbers and the heat being produced is reduced, indicating the end of the active composting process. There are few steps in compost production. Such as Collection & Source Separation of Compost Feedstock, Feedstock Preparation, Active Composting, Curing & Screening, Quality Assurance, Completing the Cycle [12].

Another inorganic waste is incinerated in an eco-friendlial way. To avoid releasing of CO₂, water is sprayed as small droplets which only release water vapours to air. Ash formed in this method is with very small particles and is being used in compost production system or directly used as fertilizers to plants in the garden.

Liquid waste: Mainly liquid waste is formed in all types of cleaning processes such as cleaning of raw materials, cleaning of equipment, cleaning of machinery, cleaning of floor etc. All waste effluents formed ore subjected to wastewater treatments and again used for the cleaning purposes after Quality checking. In the wastewater treatment process converting of wastewater (water that is no longer needed or is no longer suitable for use) into water that can be discharged back into the environment is done. It's formed by a number of activities like bathing, washing, using the toilet, and rainwater runoff. Wastewater is full of contaminants like bacteria, chemicals and other toxins. The aim of the treatment is reducing the contaminants to acceptable levels

to make the water safe for discharge back into the environment.

The following is a step by step process of how wastewater is treated [13].

- Wastewater Collection
- Odor Control
- Screening
- Primary Treatment
- Secondary Treatment
- Bio-solids handling
- Tertiary treatment
- Disinfection
- Sludge Treatment

4 CONCLUSION

In Sri Lanka, the consumers have become accustomed to avocado consumption over a long period of time. Instant avocado cube is a better newly developed value-added product from avocado which is also the best preservation method for avocado fruit. This product gives an opportunity to meet the local as well as export market demand, thereby increasing the avocado farmer's income as well.

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