A REVIEW ON THE EFFECTS OF CHEMICAL PRE-TREATMENTS ON PHYSICOCHEMICAL, SENSORIAL, ANTIOXIDANT, HUMAN HEALTH, AND MICROBIOLOGICAL SAFETY OF DRIED FRUIT

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Abstract: Dried fruits known as a nutritious snack, a substitute to sweet or salty snacks due to their flavour, nutritional, and health benefits. In producing dried fruit, it generally undergoes a drying process. However, fruit usually will encounter physical and chemical degradation after drying. Chemical pre-treatment is commonly used before the drying process as it helps to inactive enzymes and produce better quality dried fruit. It is of interest to study the effect of chemical pre-treatment on qualities of dried fruits. In this review, an overview of dried fruits in terms of processing, composition and the effect of chemical pre-treatment on physicochemical properties (colour, texture, pH, total soluble solid, titratable acidity, water activity and moisture content), sensory acceptability, antioxidants (vitamin C and total phenol content), human health and microbiological safety have been discussed. Chemical pre-treatment such as citric acid and potassium metabisulfite among the most commonly used pre-treatments. Moreover, chemical pre-treatment helps enhance colour and minimize the shrinkage of dried fruit as compared to untreated one. It also enhances the dried fruit's acceptability and increases vitamin C, total phenol content and provides microbiological safety of dried fruit. Therefore, chemical pre-treatment before drying is important in producing good quality dried fruits. This research will be beneficial to the food industry which produces dried fruit products as this review provides more information about chemical pre-treatments that are suitable to be applied on their product.

Keywords: Dried fruit, chemical pre-treatment, citric acid, physicochemical, sensory

1. Introduction

Chemical pre-treatments are usually used before drying to inactive enzymes and produce better quality dried fruits The enzymatic reactions transform the colour of the dehydrated fruit to darker colour because of the oxidation of phenols to o-quinones (polymeric pigment). To enhance dried fruit quality, applying chemical pre-treatment on fruit before the drying process is one of the solution to prevent quality deterioration of the dried fruit.

Previous studies only focus on phytochemicals and antioxidant efficacies of dried fruit. There is still a lack of review papers done so far on the effect of chemical pre-treatment on qualities such as physicochemical, sensorial, antioxidant, effects on human health, and microbiological safety of dried fruits. Moreover, this review will enhance the knowledge about chemical pre-treatments available for fruits and reflects which area researchers need to focus on. This research will also be beneficial to the food industry which produces dried fruit products as this review provides more information about chemical pre-treatments to be applied on their product. In this review, an

overview of dried fruits in terms of processing, nutrient composition, the chemical pre-treatment available for fruits and the effects of chemical pre-treatment on physicochemical, sensorial, antioxidants, human health and microbial safety of dried fruits have been discussed.

2. Discussion

2.1. Overview of dried fruit

The term "dried fruit" refers to a variety of various processing methods of fresh products. Dried fruits such as dates, figs, apples, and pears are convectional dried fruits that are produced by the elimination of water. Table 1 shows several recent studies on the nutrient content of dried fruits (USDA, 2020; Khairuddin et al., 2017). Each type of dried fruits has different nutrient composition which make them unique from one another. Pre-treatment is commonly used to inactivate enzymes and improve the consistency of dried products prior to the drying. Chemical pre-treatment including ascorbic acid, citric acid, potassium metabisulfites among the most commonly used chemical pre-treatments for fruit (Dereje & Abera, 2020a).

Table 1. Nutrient composition of selected dried fruits.

Dried fruit	Mangoes	Dates	Apples	Figs	Apricots	Raisins
Water content (%)	16.60	21.68	31.76	30.00	30.89	15.46
Energy (kJ)	319.00	303.00	243.00	249.00	241.00	299.00
Protein (g)	2.45	2.93	0.93	3.30	3.39	3.30
Fat (g)	1.18	0.20	0.32	0.92	0.51	0.25
Carbohydrate (g)	78.60	72.20	65.89	63.90	62.64	79.32
Total sugar (g)	66.30	48.60	57.19	47.90	53.44	65.18
Calcium (mg)	0.00	71.34	14.00	162.00	55.00	62.00
Iron (mg)	0.23	0.95	1.40	2.03	2.66	1.79
Magnesium (mg)	20.00	49.33	16.00	68.00	32.00	36.00
Potassium (mg)	273.00	868.70	450.00	680.00	1162.00	744.00

Note: Data is for convectional dried fruits which is defined as those with no added sugars, typically sun-dried or dried with minimal processing.
Source: USDA (2020); Khairuddin et al. (2017).

2.2. Effects of chemical pre-treatments on physicochemical properties and sensory acceptability of dried fruit

Chemical pre-treatments such as citric acid and sodium metabisulphite showed higher lightness value and help reduce the enzymatic browning. In terms of texture, chemical pre-treatment such as a combination of 0.15% sodium metabisulfite and 3% calcium chloride before oven drying showed minimum hardness compared to untreated fruits (Wijaya, 2018). Next, in terms of pH and water activity, chemical pre-treatment lowered the pH and water activity of dried fruit due to the absorption of the filling solution such as citric acid (Dereje & Abera, 2020a).

Besides that, chemical pre-treatment before fruits drying also resulted in increment of total soluble solid in dried fruits due inactivation of enzymes to avoid loss of organic acids, mineral salts, sugar and amino acids (Dereje & Abera, 2020a). Moreover, fruit treated with citric acid pre-treatment results in higher value of titratable acidity due to reaction between free amino groups and reducing sugars available in fruits causing the formation of intermediate compounds such acid and carbon dioxide. Besides, chemical pre-treatments such as citric acid help lowering the moisture

content of dried fruits due to leaching results that affect the tissue of fruit that encourages elimination of water during the drying process (Zzaman et al., 2021). Furthermore, the chemical pre-treatments such as 3% citric acid helps increase the sensory acceptability of dried fruits as citric acid prevents the crystallization of sugar, thus enhancing the quality of dried fruits especially in terms of texture (Pawar et al., 2017).

2.3. Effect of chemical pre-treatments on antioxidants of dried fruit

Most chemical pre-treatments such as sodium chloride with a combination of drying methods will affect degradation of vitamin C content due to temperature sensitivity. However, when comparing between types of chemical pre-treatment, citric acid pre-treatment showed higher vitamin C content in dried fruit as compared to sodium chloride pre-treatments because of the nature of this organic acid pre-treatment that contains vitamin C (Dereje & Abera, 2020a). In terms of total phenolic content, pre-treatments before drying methods help to increase the total phenol content and minimize the phenolic degradation on dried fruit. This is due to the ability of chemical pre-treatment to prevent the tissue damage in dried fruits (Zzaman et al., 2021).

2.4. Effects of chemical pre-treatments on human health effect and microbiological safety

Chemical pre-treatment such as sulfites pre-treatments including potassium metabisulphite and sodium sulfate showed adverse effects on human health especially those who have allergy and sulfites sensitivity such as people who have asthma. Finally, chemical pre-treatment has a positive impact on microbiological safety. Pre-treatment with acidic solutions such as ascorbic acid, citric acid, or pre-treatment by immersion in sodium metabisulfite conjointly improves the degradation of possibly pathogenic bacteria (Dereje & Abera, 2020b).

3. Conclusion

The study showed that chemical pre-treatment methods before the drying process overall give better effects on qualities of the dried fruit. Chemical pre-treatments such as citric acid and sodium metabisulphite help reduce the enzymatic browning of dried fruit. Chemical pre-treatments are proven to enhance the dried fruit's acceptability from the sensorial point of view and recorded increases in vitamin C and total phenol contents. Further research should be done to investigate the effects of chemical pre-treatments on active compounds such as flavonoids. The issue about the mycotoxins that were found in dried fruits could also be explored in further research.

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