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NUTRITIONAL, PHYSICO-CHEMICAL AND ANTIOXIDANT EVALUATION OF PROCESSED CITRUS FRUITS (KINNOW AND MOSAMBI) PEEL POWDER

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ABSTRACT

Citrus fruits peel known as by products, are powerful source of healthy substances such as phytochemicals, antioxidants and nutrients. The research focus to evaluate nutritional, physico-chemical and antioxidant analysis of processed (steaming, boiling, blanching, sun drying and oven drying) kinnow and mosambi peel powder. The proximate analysis shows the presence of the moisture, fat, fiber, protein and carbohydrate in various concentrations. Physico-chemical properties were shows high in kinnow sun dry processed and oven dry peel powder. Antioxidants were evaluated and show the high vitamin C content in blanched kinnow sun dry peel powder. Phenol content was high in boiled sundry kinnow peel powder. Ferric reducing ions were high in boiled and blanched kinnow sun dry peel powder. All the antioxidants were shown the high presence in steamed sundry mosambi peel powder. Blanched and steamed oven dry kinnow peel powder was shown high vitamin C and ferric reducing ions. Total phenol content was high in boiled and blanched sundry kinnow and mosambi peel powder. Blanched oven dry mosambi peel powder was shows high vitamin C content. Boiled and steamed oven dry mosambi peel powder was shown high ferric reducing ions. Results recommended the consumption of these peels of desired physiochemical properties as sources of food fibres or low-calorie bulk ingredients in food application.

KEYWORDS: Nutritional, Antioxidants, Physico-chemical, Peel.

INTRODUCTION

Citrus fruit have long been valued as part of nutritious and tasty diet, the flavors provided by citrus is among the most preferred in the world. Citrus fruits are rich source of vitamin, mineral and dietary fiber.[1] Some other biological compounds found in citrus and other plants can also help to reduce the risk of many chronic diseases. Along with vitamin C citrus fruits contain essential nutrients, potassium, folate, calcium, niacin, phosphorus, magnesium, copper, riboflavin, pantothenic acid and variety of phytochemical being a plant food, it contains no cholesterol, fat and sodium.[2] Citrus fruit are important among population who need to overcome and prevent micronutrient deficiencies as well as those concerned of over-nutrition, obesity and diet related chronic diseases.[3]

Citrus fruit are highly responsible for the phytochemical knows as the limonoids. Therefore, citrus fruits could be categorized as functional foods containing component shown to have health promoting and anti-cancer activities.[4] These components include the ascorbic acid, limonoids, carotenoids, folate, flavonoids.[5,6] Substances have been shown to prevent a variety of cancers and cardiovascular diseases.[7,8] Free radicals have been claimed to play an important role in affecting human health by causing several diseases including cancer, hypertension, heart attack and diabetes.[9,10]

Peel known as by product (waste) are highly perishable and seasonal, is a problem to the processing industries and pollution monitoring agencies. There is always an increased attention in bringing useful products from waste materials.[11,12] In current Citrus industry, emphasis are laid only on that, fruit peels produced in great quantities during the process are mainly discarded as waste. For this reason, researchers have focused on the utilization of citrus products and by-products.[13,14]

The product resulting from the processing of citrus fruits are the juices, essential oils and peel. The later together with the pulp and seeds are industrial residue and accounts for 40-60% weight of material.[15] Utilization of this residue is a fundamental requirement of food

processing industry. The main by product from this residue are peel, citrus molasses, pectin, extract, seed oil.[16] By products of citrus fruits like peel, are powerful source of healthy substances such as phytochemicals, antioxidants, antimicrobial, vitamins and nutrients. Processed citrus fruits peel is a valuable source of neutraceuticals and relatively a new class of ingredient.[17,18]

Many kinds of antinutrient and oils are presents in peels, some processing is beneficial to reduce these factors like blanching, steaming and boiling is commonly used in food processing to inactivate enzymes and destroy microorganisms.[19,20] These processing exposing are vegetables or fruits to high temperatures for a short time. This process not only prolongs the shelf life of fruits by inactivating the enzymes. Blanching, boiling and steaming conditions at a level just sufficient to cause inactivation of the deleterious enzymes but with minimal effect on other beneficial attributes.[21,22]

The main aim of this study is to provide a brief overview on the processing of citrus fruit peel. The nutritional analysis of processed peel proves that by products are rich in different bioactive components as well as nutrients. By using various foods processing techniques we can improve the nutritional characteristics of peel and also enhance the recent knowledge on the application of citrus fruits peel as functional ingredient.

MATERIALS AND METHODS

Collection of raw materials

The peel powders of citrus fruits (kinnow and Mosambi) were prepared in Banasthali vidyapith. Processing of citrus peels done by different processing methods such as blanching,[23] boiling for sixteen minutes and steaming for five minutes,[24] after that drying out it by sun drying for three days[25] and oven drying method for (35-55^0 C) for 3 minutes[26] and then makes powder.

Proximate composition

Proximate composition of processed citrus fruits peel powder (kinnow and Mosambi) like as moisture, fat, fiber, protein estimation was done by MicroKjeldhal method and carbohydrate were estimated by difference method.[27]

Physico-chemical analysis

Physico-chemical analysis of processed citrus fruits peel powder (kinnow and Mosambi) like as ash.[27] Water acidity and pH of processed citrus fruits peel powder (kinnow and Mosambi) was determined using the methods described by the Analytical association of Official Chemist.[28]

Antioxidant analysis

The aqueous extract of citrus fruits peel powder (kinnow and Mosambi) was extracted for the antioxidants analysis were done on processed citrus fruits peel powder (kinnow and Mosambi) like as total phenol,[29] vitamin C[30] and ferric reducing ions.[31]

RESULTS AND DISCUSSION

Proximate composition of sundry Kinnow and Mosambi peel powder

Table 1 showed that Effect of different processing on the proximate composition of sundry kinnow. Moisture content of the steamed sundry kinnow peel powder was high 13.30%, fat content was same in all processing methods, fiber content of boiled kinnow sun dry peel powder was high 4.70% in the comparison of other processing, protein and carbohydrate content of blanched kinnow sun dry peel powder was increased 4.6% and carbohydrate was 75.10% than the others processing methods.

Results of the sundry Mosambi peel powder in table 1 also showed that moisture content of the steamed peel powder was increase 17.50%, fiber content of the steamed mosambi peel powder was increase 4.50% than the other processing methods, protein content of boiled mosambi peel powder was increased like 4.40% and carbohydrate of blanched fruit peel powder was increase most 78.70% than the others processing.

Proximate composition of oven dry kinnow and mosambi peel powder

Table 2 showed that Effect of different processing on the proximate composition of oven dry kinnow peel powder showed that, moisture content of boiled and steamed were increased 14.70%. Fat content was same in all processing. Fiber content of the blanched and steamed oven dry kinnow peel powder were increased 4.70%. Protein content of the boiled oven dry kinnow peel powder was increased 5.70% and carbohydrate of the blanched oven dry kinnow peel powder was increases 73.50% than the other.

Results of the processed oven dry mosambi peel powder in table 2 showed that, moisture content of boiled mosambi peel powder was increased 16.50%, fat content was same in the all processing. Fiber content of the boiled oven dry mosambi peel powder was increased 3.50%. Protein content of the boiled oven dry mosambi peel powder was increased 5.50% and carbohydrate of the steamed oven dry peel powder was increased 75.50% than the other processing methods.

Janati et al 2012, reported the different results of proximate composition on citrus fruit lemon peel powder according to this study the protein and fiber content were high in lemon peel in the comparison of our study and fat content was also low in our study in the comparison of lemon peel powder.[32]

According to the study of Ojha et al. 2016, mandarian blanched peel powder was shows the high fiber content than the mosambi and kinnow peel powder. Protein content was decreased in mandarian blanched peel

powder than the mosambi and kinnow peel powder so the protein content was high in our study. Fat content was high in mandarian blanched peel in the comparison of kinnow and mosambi peel powder. Carbohydrate content was also increase in mandarian peel powder in the comparison of our study.[33]

Physico-chemical composition of sundry kinnow and mosambi peel powder

Table 3 showed that effect of different processing on the physico-chemical composition of sundry kinnow peel powder. Physico-chemical composition of the processed sundry kinnow peel powder like ash content was same in all processing method. Acidity in the boiled sundry kinnow peel powder was high 1.1% comparison to other processing methods. pH content in all processing were same.

Results of the physico-chemical composition of the processed sundry mosambi peel powder in table 3 showed that, ash content of the steamed sundry mosambi peel powder was increased 5.5%. Acidity of the steamed sundry mosambi peel powder was increased 1.2% than the others. pH content in all processing were same.

Physico-chemical composition of oven dry kinnow and mosambi peel powder

Table 4 showed that effects of different processing on the physico-chemical composition of oven dry kinnow and peel powder. Physico-chemical composition of the processed oven dry kinnow peel powder like as ash content of the boiled and steamed oven dry kinnow peel powders were increased 1.3%. Acidity of the steamed peel powder was increased 1.3% than the others. pH content in all processed peel powder were same.

Results of the physico-chemical composition of the processed sundry mosambi peel powder in table 4 showed that, ash and acidity content in steamed oven dry mosambi peel powder was increased 1.4% ash and 1.2% acidity in the comparison of other processings. pH content in all processed peel powder were same.

Bamise and Oziegbe 2013, study revealed that low pH of the lemon fruit in the comparison of our study. Acidity of lemon citrus fruit powder was high in the comparison of our study mosambi and kinnow peel powder.[34]

(Osarumwense et al. 2013 revealed that Citrus sinesis peel powder was shown high ash content that is 14.35% than the studied mosambi and kinnow peel powder.[35]

Antioxidant analysis of sundry kinnow and mosambi peel aqueous extract

Table 5 showed that effects of different processing on the antioxidants content of sundry kinnow peel powder. Vitamin C content of the blanched kinnow peel powder was increased 27.60%. Total phenol content of the boiled sundry kinnow peel powder was high 103.60%. Ferric reducing ions of the boiled and blanched peel powder were high and steamed kinnow peel powder was less ferric reducing ions in comparison of other processing.

Results of the antioxidant content in processed sundry mosambi peel powder in table 5 showed that, vitamin C content of the steamed mosambi peel powder was increased 34.00%. Total phenol content of the steamed sundry mosambi peel powder was highly increased 111.40%. Ferric reducing ions in the blanched and steamed mosambi peel powder were high 0.29% and 0.53%.

Antioxidant analysis of oven dry kinnow and mosambi peel aqueous extract

Table 6 showed that effects of different processing on the antioxidant properties of oven dry kinnow peel powder. Vitamin C content of the blanched and steamed kinnow peel powder were increased 28.00% than the other processing. Boiled oven dry kinnow peel powder was showed high total phenol content that is 96.10% and ferric reducing ions of steamed oven dry powder was increased 0.49% than the other processing.

Results of the antioxidant content in processed sundry mosambi peel powder in table 6 showed that, vitamin C content in oven dry blanched mosambi peel powder was increased 31.00%. Total phenol content in boiled oven dry mosambi peel powder was increased 95.60%. Ferric reducing ions of the steamed peel powder was 0.49% high than the others processing.

Arora and Kaur, 2013, reported a study on orange peel the results was shown the high content of phenol in the comparison of our study kinnow and mosambi peel powder.[36]

Syed et al, 2012 reported the vitamin C content in orange that is 43.0% was also higher than the study.[37]

Table 1: Effects of different processing on the proximate composition of sundry Kinnow and Mosambi peel powder.

Nutrient composition %	Boiling	Blanching	Steaming	Boiling	Blanching	Steaming
	Sundry kinnow peel powder			Sundry Mosambi peel powder		
Moisture	9.80	13.00	13.30	12.80	12.10	17.50
Fat	1.50	1.50	1.50	0.50	0.50	0.50
Fiber	4.70	4.50	4.60	3.30	3.40	4.50
Protein	4.50	4.60	4.50	4.40	4.00	4.20
Carbohydrate	73.80	75.10	74.60	77.70	78.70	71.90

Table 2: Effects of different processing on the proximate composition of oven dry kinnow and mosambi peel powder.

Nutrient composition %	Boiling	Blanching	Steaming	Boiling	Blanching	Steaming
	Oven dry kinnow peel			Oven dry mosambi peel		
Moisture	14.70	14.60	14.70	16.50	15.00	13.60
Fat	1.50	1.50	1.50	0.50	0.50	0.50
Fiber	4.50	4.70	4.70	3.50	3.30	3.40
Protein	5.70	4.60	4.40	5.50	3.70	5.40
Carbohydrate	72.30	73.50	73.40	72.90	74.40	75.50

Table 3: Effects of different processing on the physico-chemical composition of sundry kinnow and mosambi peel powder.

Physico-chemical composition%	Boiling	Blanching	Steaming	Boiling	Blanching	Steaming
	Sundry kinnow peel powder			Sundry mosambi peel powder		
Ash%	1.5	1.5	1.5	1.2	1.3	5.5
Acidity %	1.1	1.0	1.0	0.8	1.0	1.2
pH	5.5	5.5	5.5	5.5	5.5	5.5

Table 4: Effects of different processing on the physico-chemical composition of oven dry kinnow and mosambi peel powder.

Physico-chemical composition%	Boiling	Blanching	Steaming	Boiling	Blanching	Steaming
	Oven dry kinnow peel powder			Oven dry mosambi peel powder		
Ash%	1.3	1.1	1.3	1.1	1.3	1.4
Acidity %	1.0	1.2	1.3	0.8	0.9	1.2
pH	5.5	5.5	5.5	5.5	5.5	5.5

Table 5: Effects of different processing on the antioxidant analysis of sundry kinnow and mosambi peel aqueous extract.

Antioxidant analysis %	Boiling	Blanching	Steaming	Boiling	Blanching	Steaming
	Sundry kinnow peel powder			Sundry mosambi peel powder		
Vitamin C	23.50	27.60	25.90	21.30	25.90	34.00
Total phenol	103.60	82.10	56.70	48.10	45.10	111.40
Ferric reducing ions	0.47	0.47	0.46	0.25	0.29	0.53

Table 6: Effects of different processing on the antioxidant analysis of oven dry kinnow and mosambi peel aqueous extract.

Antioxidant analysis %	Boiling	Blanching	Steaming	Boiling	Blanching	Steaming
	Oven dry kinnow peel powder			Oven dry mosambi powder		
Vitamin C	20.00	28.00	28.00	23.50	31.00	21.40
Total phenol	96.10	91.50	77.50	95.60	91.30	45.60
Ferric reducing ions	0.37	0.42	0.47	0.35	0.29	0.49

CONCLUSION

In conclusion, the evaluation of the proximate composition of processed kinnow and mosambi peel powder are valuable source of nutrients. The elemental analysis shows that it contains some nutrients required for normal functioning of the body system. Previous work revealed that it is a good source of total polyphenols and has good antioxidant properties which will make it a useful ingredient in the preparation of various food products. Overall, the results suggested that kinnow and mosambi waste could be used as a raw material for many products. From industrial point of view, mosambi peel which is the residues from processing industry could be further processed for value addition of various food products.

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