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VALUE ADDITION IN CITRICULTURE

Muhammad Inam-ur-Raheem*, Faqir Muhammad Anjum and M.S. Butt
Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan
*Email: rahim12july@yahoo.com

Abstract

Citrus is a non-climacteric fruit and harvested with the reaching up to desired juice contents (30-40%). Citrus cultivars are grown in tropical or sub tropical climacteric areas of the world and divided into different groups like sweet oranges, mandarin, grapefruit, lemon and lime. In Pakistan citrus fruits are grown in all provinces on the area of 160 thousand hectares with production of 1.5 million tonnes annually. Out of the total production, 0.2 million tonnes of citrus fruits are exported to different countries against 30 million dollars. Through value addition there is a possibility to earn more foreign exchange from the export of different citrus products and by products (prepared from seed, peel and rag). On structural basis citrus fruit may be divided into its different components like juice concentrate, pulp, peel, fiber (rag) and seeds. With the development and export of just juice concentrate we can get quite more foreign exchange as compare to fresh fruit. Moreover, orange squash, syrup, jam, jelly, marmalade and some fermented products can be prepared from citrus juice concentrate, as a major product. On the other hand a number of by products like pectin, citric acid, essential oil, flavonoids, antioxidants and limonoids can be prepared from its peel and seed. Moreover citrus rag may use as cellulosic compounds

INTRODUCTION

Citrus is a non-climacteric fruit with low starch contents. This gives rise in shelf-life due to low rate of respiration process during storage conditions after harvesting as compare to the climacteric fruits and high starch concentrations. Citrus cultivars are widely grown in warm climates worldwide but tropical and sub-tropical areas are the ideal climatic requirement for the growth of a quality fruit with high yield. No doubt it was originated in tropical areas around Southern Himalayas, South eastern Asia and Indonesia Archipelago, but it was spread throughout the world on both sides of equator. A number of varieties of citrus fruits are present in the international market but commercially sweet oranges, mandarin, grapefruit, lemon & lime are preferably available on the basis of their unique flavours, taste from sweet to sour and likening of consumers. Citrus fruit stands first as a tree fruit in the world on the basis of area & production. Brazil, USA and China are big growers whereas USA is the big consumer world wide. In Pakistan Citrus fruit ranks first position as compare to the other fruit in reference to area, production & export. In Pakistan within the area of 160 thousands hectares the production of citrus fruit is about 1.5 million tonnes per annum whereas 30% of total production of different varieties especially Kinnow is exported to different foreign countries. The demand of Pakistani Kinnow is higher in

foreign countries as compared to the Kinnow of other countries (Anonymous, 2005).The province of Punjab produces about 95% of country's total citrus fruits out of which the main areas are divisions of Sargodha, Faisalabad, Toba-tek-sing, Multan and Bahawalpur. About 25% of total citrus fruits are just growing in Sargodha, 20% in Faisalabad, 19% in Multan & Bahawalpur divisions. Lahore, Gujranwala and D.G. Khan Divisions are also enhancing their production rate in producing citrus fruits. Present world trade situation regards of whole citrus fruit, its juice and processed products is mentioned in Table 1 and its general composition in Table 2. On weight and percentage basis generally citrus fruit varieties are divided into four different components juice, peel, seed with 40-58%, 25-35%, 5-7% and 12-15%, respectively. In reference to structural composition, the citrus fruit is mainly divided into peel (non-edible) & endocarp (edible portion containing carpals). Flavedo is the outer covering while albedo is inner spongy white portion of citrus peel. The carpals consist of vesicles (sacs) and seeds.

Table 1: World trade situation in reference to whole citrus fruit and its products

Commodity	Quantity (million tonnes)	Value (US$ billion)
Fresh fruit	9.0	4.0
Juice	1.0	2.0
Other processed products	----	2.0
Total	----	8.0

Table 2: Detailed composition/nutritional value of oranges

Composition	Value (100 g^{-1})
Energy	50Kcal (190kJ)
Carbohydrates	11.54 g
Sugars	9.14 g
Dietary fiber	2.4 g
Fat	0.21 g
Protein	0.70 g
Thiamin (vitamin B_1) 0.100 mg	8%
Riboflavin (vitamin B_2) 0.040 mg	3%
Niacin (vitamin B_3) 0.400 mg	3%
Pantothenic acid (B_5) 0.250 mg	5%
Vitamin B_6 0.051 mg	4%
Folate (vitamin B_9) 17 µg	4%
Vitamin C 45 mg	75%
Calcium 43 mg	4%
Iron 0.09 mg	1%
Magnesium 10 mg	3%
Phosphorus 12 mg	2%
Potassium 169 mg	4%
Zinc 0.08 mg	1%

MAJOR CITRUS PRODUCTS

Major citrus products are sweet juice, frozen concentrated orange juice (FCOJ), non frozen concentrate (NFC) Orange Juice, squashes (orange, lime, lemon and lemon barley), natural syrups, jam, jelly and marmalade.

1. Sweet Juice

Orange juice can be prepared through a variety of processes but the pressing method is recommended as a best method for juice extraction instead of crushing method. while in crushing process seeds also crush down and as result bitterness happens in juice with the spreading of limonene (present in seed). Bitterness in grapefruit develops due its bitter tasted rag. This problem can minimize with the application of biotechnological technique by identifying and transferring gene form sweet mandarin.

2. Juice concentrate

Frozen concentrated orange juice (FCOJ) is prepared through evaporating the required amount of water to attain 65ºBrix. On achieving desired brix (concentration of sugar contents in juice) the juice is to be stored at freezing temperature of 20ºF or lower up to its consumption time. But in case of non-frozen concentrates (NFC) orange juice is to be pasteurized with the advantage of enhancement in its shelf-life up to one year. In non-frozen concentrates (NFC) process there is no need to remove water from orange juice therefore its transportation cost increases up to 6-7 times more than FCOJ.

3. Squashes

Different types of squashes can be prepared from citrus fruit juices but most commonly are prepared as orange squash, lime or lemon squash and lemon barley. Citrus squashes are prepared from a simply filtered orange juice pulp with a homogeneous mixture of sugar, citric acid, flavour, colour and preservative Potassium meta-bi-sulphite (KMS). Finally required brix (sugar concentration) is about 45^{o}Brix. There is no need to remove water through evaporation process in different squashes. The shelf-life of squashes can only be improved simply up to one year with the use of a preservative. After attaining required homogeneous mixture it is packed in a suitable sterilized containers or bottles and then stored at room temperature.

4. Natural Syrup

Natural syrup of citrus can be prepared through a homogeneous mixture of orange juice extract, sugar, liquid glucose, pectin, citric acid, colour, flavour and preservatives up to finally desired brix of 65 - 68^{o} by applying heat. The syrup is packed in sterilized bottles prior to falling its temperature from 79°C with the advantage of minimizing the chances of oxidation problem.

5. Jam, Jelly and Marmalade

Final brix of 68 - 70^{o} is required for the production of jam, jelly & marmalade, prepared through evaporation process. Preparatory process of these products is nearly same and prepared through a homogeneous mixture of citrus juice, sugar, pectin, citric acid, flavour, colour and preservative with the application of heat. But the main difference on , jam is opaque jelled product prepared from a juice pulp without extra removal of its fiber contents, in jelly it is need to get just a juice extract with the filtration of its fiber contents up to maximum level for attaining transparent property, whereas in case of marmalade little amount of blanched sweet orange peels (bitterness free) are required.

WASTE UTILIZATION

Nearly 30% of world's total citrus production goes for processing and in some countries its wastes is further utilized as such or in dehydrated form to develop a variety of by products. Detailing of some of these products is mentioned below.

BY PRODUCTS

1. Citrus oil: Citrus oils are present in numerous oil sacs and vesicles located in the flavedo (outer portion of peel) and carpals respectively. The peel oils can be used in manufacturing citrus beverages, confections and baked foods. Moreover it is also used in preparing different types of cosmetics, perfumes, pharmaceuticals and for scenting soaps. In commercial practices the essential oils is extracted through a mechanical rupturing system of oil sacs. Expressing the oil as an aqueous emulsion for which it is separated by centrifuging. This is also called as cold-pressed oil since no heating processing or distillation is involved. Cold pressed oils of orange, grapefruit and lemon extracted in this way are preferred while in case of acid/sour lime, and the product of traditional West Indian procedure is liked by the consumers, and is commercially produced by distillation of pulp. The distilled lime oil lacks the natural bouquet of cold pressed oil but has a distinct terpeny odour. Acid lime pulp or sludge left over during the clarification of lime juice for cordial making, contains 0.8-4.0% lime oil, which can be recovered by steam distillation (Jain et al., 1952)

2. Seed oil: Citrus seed contain 30-45% oil on dry weight basis. The seed oil is bitter and inedible but it can be utilized as a source of major fatty acids and in manufacturing cosmetics, pharmaceuticals, scenting soaps, detergents and as a nutritious poultry and animal feed. The citrus seed contains major fatty acids palmitic (22.30%), stearic (2-5%), oleic (20-25%), linoleic (37-45%) and linolenic (3-5%). Nutritionally seed meal contains proteins, fats and crude fiber with percentage of 32.5%, 7.5% and 8% respectively (Attaway and Moore, 1992).

3. Pectin: Pectin is an important component of citrus fruit. Pectin contributes to viscosity and act as a stabilizing or gelling agent in manufacturing jam, jelly and marmalade. Moreover pectin improves the mouth feel on drinking citrus juice due to its emulsifying character. Pectin also has a therapeutic value and grapefruit pectin has been shown to lower serum cholesterol level in human subjects and to reverse atherosclerosis in animals (Attaway and Moore, 1992). Albedo (inner spongy portion of citrus peel) and apple Pomace are the two most important sources of pectin in the technologically advanced countries of the world (Francis and Bell, 1975).

4. Citrus molasses: Molasses can be prepared by treating waste residue (peels and Pomace) with 0.20-0.50% calcium hydroxide (lime) and then allow to react and release bound juice/press liquor from lime treated peels. The liquor is concentrated to get molasses. The pressed liquor contains 9-15% soluble solids of which 60-70% is sugars. The press liquor from 'Nagpur' mandarin peel pressed in hydraulic press contains 15% soluble solids mostly sugars. These solids can be concentrated and fed to cattle. The concentrated molasses have 70^{o}B and moisture content up to 29% mixed with citrus pulp to sweeten the cattle feed.

5. Flavonoids: Citrus fruits contain high amounts of flavonoids (extracted form flavedo), have therapeutic value against allergy and other inflammatory diseases and also have beneficial effects on capillary fragility and atherosclerosis (Attaway and Moore, 1992). Moreover flavonoids also act as an antioxidant. Hesperidin and naringin are the major flavonoids commercially produced from citrus waste. Hesperidin solution is tasteless and used as therapeutic agent in pharmaceutical industry and naringin is used to impart slight bitter taste in beverages, confections and marmalade made from sweet oranges.

6. Flavour: A major by product of the citrus processing industry is a hydrocarbon, d-limonene (extracted from pressing of citrus seeds). With the application of different experiments d-limonene is made useful flavouring compound for manufacturing perfumery compounds (Ravindranath, 1980) and as a tobacco flavour.

7. Sweeteners: Hesperidin and naringin are readily available as products of citrus processing industry and can be further used to produce sweeteners without calories. Naringin is bitter but is dihydrochalcone is sweet. Similarly neohesperidin is bitter but neohesperidin dihydrochalcone is sweet. Hesperidin is tasteless but hesperitin dihydrochalcone is sweet.

8. Carotene: B-carotene which imparts yellow to orange colour extracted from citrus peel use as a natural colouring agent in different food products. It is more soluble in fats and oils than water.

Carotenoid pigments can be extracted from dried and powdered orange peels with acetone or hexane.

9. Biogas: Orange peel and peel oil can be digested an-aerobically to yield biogas (Lane, 1985). This biogas contains 50-55% methane and converts into 100% in natural gas.

10. Animal Feed: Mostly animal feed is prepared from peel, rag and Pomace of citrus fruit. These constituents are highly nutritive and sweet in taste. Moreover it can be used in wet as well as dehydrated condition.

CONCLUSION

Improvement in public awareness is most important for utilization of whole citrus fruit can provide number of benefits through different ways like efficient utilization of agro industrial based for value added products. There is a great possibility to flourish the allied industry related to citrus and its by products to generate the manpower. Through these ideas new industries can be established that help to minimizing the cost of production of major products, creating the opportunities of new jobs and ultimately that improve the overall economy.

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