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Studies on Extraction of Essential Oil and Pectin from Sweet Orange

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Abstract

The essential oil and pectin extraction from sweet orange were studied. The physical characteristics of sweet orange were found color (greenish yellow). The wt of peel, juice, pomace and seed was 47.1, 77.65, 66, 12.6 g respectively. The yield of essential oil obtained from flavedo peel layer is 3.02%. Further the physicochemical characteristics of essential oil were found yellowish liquid appearance, orange odor, relative density (21.02 g/ml), specific gravity (0.841 g/ml), solubility in alcohol (soluble in 95% but insoluble in 90%), peroxide vale (3.5), evaporation residue (4.25%), flash point (48^{0}C), aldehyde (1.3%) and ester content (2.0%). The yield of pectin extracted by acid precipitation method from albedo peel layer was 20.12%. Further the physicochemical characteristics of pectin were found color (brown), moisture content (3.78%), ash (0.62%), degree of methoxylation (9.2%), gel grade (150%) and calcium pectate (7.40%).

Keywords: Sweet orange; Physico-chemical characteristics; Essential oil; Pectin

Introduction

Citrus is one of the most important fruit crops grown throughout the world. Further it is made up of many species that vary in importance due to different climatic zones. Citrus fruits belong to the plant family *Rutaceae* sub family *Aurantiodeae* which comprises 33 well-known genera and 203 species. The true citrus fruit group which has a berry fruit called hesperidium consists of six genera i.e. *Citrus fortunella, ponciru, microcitrus, eremocitrus and clymenia.* The genus citrus is evergreen unifoliate and consists of two sub-genera, papeda and cucitrus. The fruits of papeda are inedible because of numerous droplets of acrid oil the juice sacs. Eucitrus consists of eight important commercial cultivars grown throughout the world. These are Sweet Orange (*Citrus sinensis*), Grapefruit (*Citrus paradisi*), Sour orange (*Citrus quarantium*), Mandarin (*Citrus reticulata*), Lemon (*Citrus limon*), Lime (*Citrus aurantifolia*), Citron (*Citrus medica*). Among all the citrus fruits produced either for export or local markets, sweet orange contributes 71 percent of the total citrus fruit production in world. Brazil is the largest producer of orange followed by USA. Oranges are the second largest fruit grown and processed in the world after grapes. Orange is the 3rd largest producing fruit in India after mango and banana. The major orange producing states of India are Andhra Pradesh, Maharashtra, Karnataka, Punjab and Rajasthan. In Maharashtra, citrus is grown in the districts of Ahmednagar, Nasik, Pune, Parbhani and Latur on an area of 0.45Lakh ha. Nucellar Mosambi, Mudkhed seedless and *Rajapui* are the major cultivars of sweet oranges cultivated in Maharashtra. In Parbhani district, Nucellar, *Mosambi* local and *Rajapimpari* are the major cultivars of sweet orange.

The fruits of sweet orange (*Citrus cinensis L.Osbeck*) are sub globose to round or oval in shape, diameter ranges from 5.7 to 9.5 cm, greenish yellow to orange in color and tightly skinned. The fruit have constituent about juice (40-50%), flavedo (8-10%) and albedo (15-30%). The fruit consists of an outer peel, which includes epidermis, flavedo, oil glands, albedo and vascular bundles. The flavedo is outer yellow sub epidermal layer containing carotenoids pigments and numerous oil glands filled with aromatic essential oils. The albedo is the inner white spongy layer of parenchymatous cells closely adherent to outer wall of segment and thickness (0.16 to 1.43 cm). It is rich in glucosides, flavonones, bitter principles, pectin and pectic enzyme. The thread like vascular bundles from albedo form a network running parallel to the fruit axis along the outside of the segments. It is rich in peroxides. The inner flesh consists of 10-12 segments, distributed around of pithy core forming central core of fruit. Each segment is surrounded by thin wall carpellary membrane called septum. The juice sacs are closely compacted, club-shaped vesicles, which completely fill the segments and are attached to the walls with small hair- like papillae. Segments of most sweet orange varieties contain 1 to 3 or 4 seeds attached by means of placentae to the septum wall. The seeds are rich in oil (30 to 40%) and bitter limonoids.

Citrus fruit processing produces many byproduct with significant value. These wastes could be used for the production of many phytochemical, pharmaceuticals, food products, food products, essential oil, seed oil, pectin and dietary fibers. These by-products are considered to be rich source of edible and health promoting agents as polymethoxylated flavonoids, many of which are found exclusively in citrus peel [1]. Orange peel remaining after juice extraction is the primary waste fraction almost 50% of fruit mass. Peel byproducts contain sugars, edible fiber and many other components that offer excellent opportunities as value-added products, particularly those components that have biological activities (antioxidant, anti-cancer, cardio protective and food/drug-interactions) or other attributes that are useful in the development of high-value food products from citrus peel [2]. Albedo layer white spongy layer below flavedo layer in orange peel is source of pectin. pectin produced from orange peel has wide spread application in food industry as gelling in jam and jellies, thickening, texturizing, emulsifier and stabilizing agents in dairy products, fruit preparation or in icings and frostings. It is generally produced by acid extraction followed by filtration and precipitation by alcohol. Flavedo

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Characteristics	Value
Color	Greenish yellow
Wt of fruits(g)	199.00
Diameter(mm)	84.06
Thickness of peel (mm)	2.34
Wt. of peel (g)	47.10
Wt of albedo (g)	31.69
Wt of Flavedo (g)	15.39
Wt of fruit without peel (g)	167.25
Wt of juice (g)	77.65
Wt of Pomace (g)	66.00
Wt. of seeds	12.60
No. of seeds	17

Each value is average of ten determinations.

Table 1: Physical characteristics of sweet orange

Particulars	Quantity	Per cent
Whole Fruit (g)	199	100
Peel (g)	47.1	23.66
Juice (ml)	81	37.95
Pomace (g)	63.9	32.09
Seed (g)	12.6	6.3

Each value is average of ten determinations.

Table 2: Percent proportion of each part of sweet orange.

Characteristics	Value
Physical	
Appearance	yellowish
Flavour	Orange
Relative density(g/ml)	21.02
Specific gravity	0.841
Solubility in ethyl alcohol	
(95%)	Soluble
(90%)	Insoluble with haziness
Yield (%)	3.02
Evaporation residue (%)	4.25
Flash point	48^{0}C
Chemical	
Peroxide value	3.5
Aldehyde content (%)	1.3
Ester content (%)	2.0

Each value is average of three determinations.

Table 3: Physicochemical characteristics of essential oil from flavedo layer of sweet orange.

layer means outer covering of peel is source of essential oil. Essential oil was one of the citrus by-products attracting keen interests of people. It is expressed from flavedo layer by methods mechanically pressing, steam distillation, super critical, solvent extraction. Expressed sweet orange oil is primarily used for flavoring beverages, soft drinks, ice cream, sweets, pharmaceutical preparations, and also perfumes [3]. Therefore the morphological characteristics, extraction and characterization of essential oil from flavedo layer and pectin obtained from albedo layer were studied.

Materials and Methods

The whole sweet orange fruits (variety Nucellar) were procured from Sweet Orange Research Scheme, Marathwada Krishi Vidyapeeth, Badnapur, Jalna, Maharashtra. The oranges were washed, wiped and then stored in the cold chamber (10^{0}C).

Determination of physicals characteristics of essential oil from flavedo and pectin from albedo layer of sweet orange peel

The physical characteristics of essential oil from flavedo and pectin from albedo layer of sweet orange peel such as appearance, odor, relative density, specific gravity, solubility in alcohol, evaporation residue and flash point ester content were determined as per standard procedure.

Determination of chemicals characteristics of essential oil from flavedo layer and pectin from albedo layer of sweet orange peel

The chemical characteristics of essential oil from flavedo and pectin from albedo layer of sweet orange peel such as peroxide value, aldehyde, ester content, moisture content, ash, degree of methoxylation, gel grade and calcium pectate were determined as per standard procedure [4].

Results and Discussion

The physical characteristics of sweet orange were found skin color (greenish yellow), average weight (199 g), average diameter (84.06 mm), thickness (2.34 mm), weight of peel (47.1 g), weight of flavedo (15.39 g), albedo layer (31.69 g), weight of fruit without peel (167.25 g), weight of 81 ml extracted juice (77.62 g), weight of pomace (66 g), weight of seed (12.6 g) and total number of seeds (17) (Table 1). The results obtained were in good agreement with the findings [5]. The percent of each part of sweet orange fruit were found peel (23.66%), juice (37.95%), pomace (32.09%) and seed (6.3%). The proportion of each part of sweet orange fruit were found weight of peel (23.66%), juice (37.95%), pomace (32.09%) and seed (6.3%) (Table 2).

Characteristics	Value
Yield (%)	20.12
Colour	Brown
Moisture (%)	3.78
Ash (%)	0.62
Degree of methoxylation (%)	9.20
Gel grade (%)	150
Calcium pectate (%)	7.40

Each value is average of three determinations.

Table 4: Physicochemical characteristics of pectin from albedo layer of sweet orange peel.

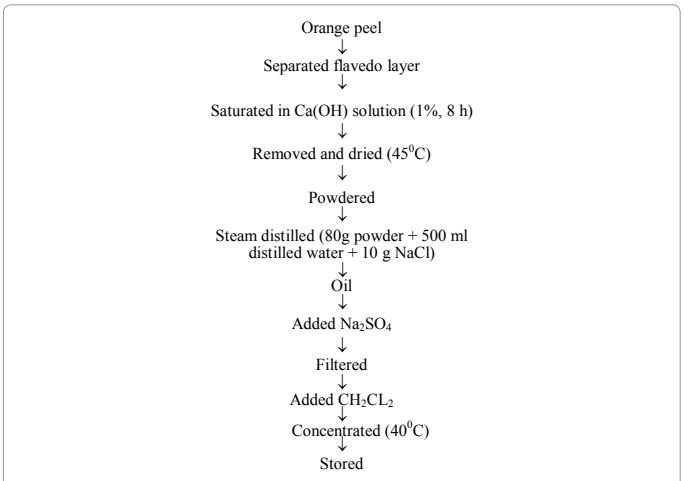

Figure 1: Flow sheet for preparation of essential oil from flavedo layer.

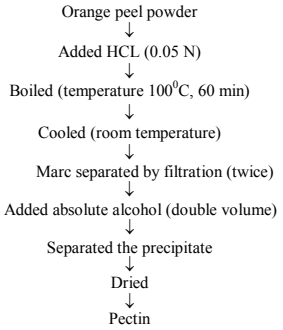

Figure 2: Flow sheet for extraction of pectin from albedo layer of sweet orange peel.

The yield of essential oil (3.02%) is obtained from sweet orange flavedo layer. The results are in good agreement [3]. The physical characteristics of essential oil were found appearance (yellowish), flavour (orange), relative density (21.02), specific gravity (0.841g/ml), solubility (90% and 95%), evaporation residue (4.25%), flash point (48^{0}C). The chemical characteristics such as aldehyde and ester content were 1.3% and 2.0% respectively (Table 3). The results are in good agreement [6]. The physicochemical characteristics of pectin obtained from dried albedo peel layer of sweet orange were found yield (20.12%), moisture (3.78%), ash (0.62%), degree of methoxylation (9.2%), gel grade (150%) and calcium pectate (7.40%) (Table 4). The degree of methoxylation was slight differ [7]. The degree of methoxylation was in the range 8-12% for citrus fruits [8]. Finally it can be concluded that the flavedo and albedo layer of sweet orange can be utilized for preparation of essential oil and pectin.

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