Mango, Orange and Mandarin Peels Oleoresins to Prepare Natural and Healthy Instant Flavor Drinks

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Abstract: Mango and citrus are major processed fruits in Egypt that results in large quantities of wastes and by-products rich in various bioactive components such as water soluble and insoluble antioxidants and essential oils. Therefore, the objective of this study was to produce instant flavor drinks from oleoresins which obtained from fruit industry wastes (mango, orange and mandarin peels). Fruit peels are natural sources for dietary antioxidants and flavor. Mango, orange and mandarin peels industrial by-products contains many nutritionally and economically valuable components. These by-products from juice processing industries have significant exploitation potential. Therefore, the present study carried out on different instant flavor drinks which were prepared as mango, orange and mandarin peels oleoresin in 20, 40 60, 80 and 100 mg/100 g formulas to produce natural and healthy instant fruit peels flavor drinks compared to commercial products. These formulas evaluated for physico-chemical properties, antioxidants contents and their activities, volatile oil fractions and sensory evaluation. The obtained results indicated that antioxidant activity of mandarin peels oleoresin due to it is high phenolic compounds content (50.51±2.41mg/g) and vitamin C (1.30±0.06 mg/g). While, total flavonoids contents (5.66±0.21 mg/g) for mango peels oleoresin showed the second level for tested peels oleoresin antioxidant activity, also mango oleoresin has high content of in carotenoids (12.53±0.43 mg/g). Mandarin peels which have the significant content of volatile oil (1.92±0.23g/100g), comparing to orange and mango oleoresin peels. Mango peels oleoresin has higher content in α-pienene, terpinolene, myrcene and β-pienene than other fractions (12.82, 3.14, 2.30 and 1.54%, respectively) Also, the major compound in orange then mandarin peels oleoresin was limonene (85.80 and 52.67%, respectively). Camphor content has highest content in orange peels oleoresin (3.62%). The most important aroma characteristic in mandarin peels oleoresin were 1,8-cineol (13.31%) followed by γ-terpinene (11.02%) then E-β-ocimene (6.52%). Orange peels oleoresin has the highest antioxidant activity by DPPH method (from 54.20 to 73.00%) in gradual concentrations followed by mango peels oleoresin (from 46.24 to 55.82%) then mandarin peels oleoresin (from 33.92 to 52.02%). These data are due to that orange peels oleoresin is rich in limonene and camphor, as well as carotenoids, flavonoids and vitamin C. Aroma in mandarin formula showed the highest one and that was due to the quantity of volatile oil and quality of some volatile oil compounds. Mango and orange peels oleoresin formulas gave also the highest evaluation in sensory acceptability which has been shown for the aroma and flavor results may be due to the highest contents in flavonoids and carotenoids and volatile oil components. Therefore, the use of mango, orange and mandarin oleoresins as natural flavors is better than commercial synthetic flavorings.

***Keywords*:** Fruit peels, oleoresin, physico-chemical properties, natural flavor, antioxidants content, sensory evaluation

INTRODUCTION

Oleoresins are the concentrated liquids form plants containing volatile oil. They are obtained from plant by extraction with aqueous and non-aqueous solvents followed by removal of the solvent by evaporation (Chen and Huang, 2016). The advantages of oleoresins, easy to stored and transported, more stable when heated, more economical to use, easier to control for quality and cleaner than the equivalent ground spices, free from contamination, concentrated form reduces storage space and bulk handling and transport requirements and Longer shelf life due to minimal oxidative degradation or loss of flavor.

By-products remaining after fruits processing have been a problem due to high transportation costs and limited availability of landfills, as these by-products have no commercial value, they are often disposed unscrupulously. Improper disposal of mango peel waste may appreciably increase the environmental pollution due to its rapid decay, eventually becoming a source of insect multiplication. A high level of biological oxygen demand (BOD) and chemical oxygen demand (COD) in mango peel waste create a further problem in disposal (Puligundla *et al.,* 2014).

Agroindustrial residue, such as seeds and peels represents about 50% of the raw process fruit (Orozco *et al.,* 2014). Orange peel represents approximately 30-40 g/100g of the fresh fruit weight (Manjarres-Pinzon *et al.,* 2013).

By-products from citrus fruits contains large amounts of high added value compounds and show a variety of valuable biologically active compounds in the citrus by-products (polyphenols, carotenoids and essential oils). The polyphenols and carotenoids are known to have numerous health benefits, mostly attributed to their antioxidant activity. It is important to note that the total content of polyphenols is higher in citrus peels, which is commonly discarded (Abd El-ghfar *et al.,* 2016). Also, essential oils are common in peels, which is a natural source of volatile substances. These uses of by-products therefore shows sustainable environmental benefits combined with increased economic gains as well as the production of nutrition food that will improve the lives of consumes.

Fruit peels are natural sources for dietary antioxidants and flavor. In order to explore the potential of fruit wastes as natural resources of bioactive compounds, the antioxidant potency and total phenolic

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contents (TPC) of lipophilic and hydrophilic components in wastes of orange and mandarin were evaluated (Casquete *et al.,* 2015). Traditionally *Mangifera indica* has medicinal application. Many phenolic compounds have been detected in mango peels, barks, puree concentrate, leaves, pulps and seed kernels. Also, fresh mango peel contains significant amount of moisture (70%) and it's rich in pectin, cellulose, hemicelluloses, lipids, proteins, flavonoids and carotenoids (Ajila *et al.,* 2007).

It is well established that polyphenol which is rich in its fractions in peel extract could be used as natural antioxidants and functional food or feed supplements (Berardini *et al.,* 2005). Mango peel is a rich source for phenolic compounds, which exhibit antioxidant activity (Palmeira *et al.,* 2012). The major phenolic compounds present in mango peel extract are reported to be syringic acid, quercitin, mangiferin pentoside and ellagic acid (Ajila *et al.,* 2010). Peels are good source of mangiferin (C-glucosyl xanthone), a heat-stable and pharmacologically active phytochemical. In a study, yogurt fortified with supplementation of 10% of mango peel powder showed a good texture, flavour and color characteristics and exhibited one month shelf life without adding preservatives (Ruiz *et al.,* 2011).

Adewole *et al.* (2014) observed that the use of citrus peel as an economically valuable source of high-added value compounds as it contains a significant various flavonoids, carotenoids, dietary fiber, polyphenols, ascorbic acid and essential oil.

The aroma is one of the most significant and decisive parameters of quality in the selection of a product. Aroma compounds are present in raw foods in free volatile form and also as nonvolatile precursors such as substituted cysteine sulfoxides, thioglycosides, glycosides, carotenoids and cinnamic acid derivatives (Solis-Solis *et al.,* 2007). The sugar moieties of glycosidically-bound aroma volatiles, which have been reported in mango, are γ-terpenyl-β-D-glucopyranosides, γ-terpenyl-6-o-rutinosides and γ-terpenyl-6-o-(-L-arabinofuranosyl)-β-D-glucopyranosides. Also, Aroma compounds (aglycones) can be released from glycosidically–bound compounds by enzymatic or chemical reactions during maturation, storage, industrial pretreatment/processing (Wetungu *et al.,* 2015). Mango varieties differ in the amount and type of flavor compounds present which is dependent on their place of origin, major and minor volatile components with the latter being the key player in their aroma.

Commercial instant flavor drinks in local market contained thickeners (sodium carboxy methyl cellulose and gum Arabic), colors (Titanium dioxide, tartrazine, sunset yellow, Allura red), sweetener (aspartame and acesulfame potassium), flavors contain soya, phenylalanine and other components. Therefore, this formula not be used for patients having phenyl ketone urea, bean allergens, pregnant and lactating women and children under 3 years (Tuormaa, 1994). Thus, this study aimed produce natural and health product in mango, orange and mandarin peels oleoresin. Also, valorization of mango, orange and mandarin peels through different routes not only can increase the profitability of fruit processing industries, but also help reduce environmental pollution.

MATERIALS AND METHODS

Mango (*Mangifera indica* L.), bitter orange (*Citus aurantium* L.) and mandarin or tangerine (*Citrus rectulata* L.) peels were collected in company producing juices in 6th October city, Egypt, then to be ready for oleoresin extraction.

Oleoresin preparation

Fresh peels samples extracted by Soxhlet extraction with ethanol used by the manufacturer. Distill of ethanol completely using high vacuum towards the end. This commercial method was applied as Indian Standard (IS 7826:2003).

Formula preparation

Table (1): Formulas constituents (g/100g on dry weight basis) contained oleoresin peels compared to commercial products

Components	Commercial product (g/100g)	Oleoresin product (g/100g)
Sugars	67.5 g	67.5 g
Fiber	1.5 g Gum Arabic 1.5 g Carboxy methyl-cellulose	1.5 g Gum arabic 1.5 g Xanthan
Soy protein	1.4 g	-
Vitamin C	0.9 mg	0.9 mg
	29.6 g Citric acid, tri-sodium citrate, salt, tricalcium orthophosphate, maltodextrin.	2.3 g Trisodium citrate 2.3 g Maltodextrin
Others	Sweeteners mixture (Aspartame and Acesulfame K) Color mixture (titanium dioxide, tartrazine, sunset yellow and Allura red) Flavor contains soy	0.6 g Natural color (β- carotene) Mango oleoresin or Orange oleoresin or Mandarin oleoresin

Physicochemical analysis

The pH of the mango, orange and mandarin peels oleoresin were measured using a pH meter (HANNA, 8417H, Italy). Moisture and total acidity (as citric acid) was determined by AOAC method (2000). Total sugars was determined with phenol–sulphuric acid method according to Masuko *et al.* (2005). The Total soluble solids (TSS) value of the oleoresins products were recorded by using rafractometer has range of 0-100^{o}Brix (Bellingham-Stanley Lt., England). In each treatment, three readings were taken and their average value was expressed in °Brix.

Antioxidants content and its activity determination

Total polyphenolic contents were measured using Folin–Ciocalteu method described by Boligon *et al.* (2009). Also, total flavonoids content as rutin was determined by Pharmacopeia (1989). While, carotenoids as β-carotene was determined according to Nagata and Yamashita (1992). Ascorbic acid was determined according to the methods of Klein and Perry (1982). Volatile oils were determined by International Standard Organization method (ISO 6571: 2009).

The antioxidant activity of the oleoresin peels were evaluated by using the 1,1diphenylpicrylhydrazyl (DPPH) assay described by Yen and Chen (1995).

Essential oil fractionation by GC.MS

GC–flame ionization detection (FID) analyses were performed on a Shimadzu system. Separations were performed on 30-m ×0.25-mm *i.d*. ×0.25-µm film thickness column. The temperature program was as follows: 50°C to 250°C at 3°C/min. The injection volume was 1.0 µL, pressure was 102 kPa at constant pressure, and carrier gas was Helium at 30 cm/s of average linear velocity. The split ratio was 1:100. The detector was set at 280°C (Mondello *et al.,* 2004).

Sensorial evaluation

The sensory attributes of color, sweetness, aroma, flavor, consistency, and overall acceptability were evaluated by 10 panelists when resolve 25 g (for each formula)/1 liter water (Ranganna, 2005).

Statistical analysis

The data were statistically analyzed using SPSS program version 19 (2000). Means and standard deviations were determined using descriptive statistics. Differences were tested for significance by using the ANOVA procedure, using a significance level of $P<0.05$.

RESULTS AND DISCUSSIONS

The yields of oleoresin on fresh weight basis for the three investigated waste peels are detrained and the results are shown in Table (2). Orange peels were the highest one in the yield of oleoresin (70.34 mg/g), then mango peels (46.26 mg/g),while mandarin was the lowest one (24.82 mg/g).

Table (2): Mango, orange and mandarin peels and its oleoresins yield on fresh weight basis

Items	Mango	Orange	Mandarin
Peels yield %	17.50±2.52	22.70±1.14	30.25±3.25
Oleoresin yield mg/g	46.26±3.50	70.34±8.55	25.82±2.81

Values are means ± Standard deviation of triplicates

Data in Table (3) show moisture, pH, titratible, acidity, total sugars and total soluble solid contents in mango, orange and mandarin peels oleoresin formulas compared with commercial products. Results indicated that, commercial products have highest contents in moisture (2.60, 2.54 and 2.52%, respectively) compared to mango, orange and mandarin peels oleoresins products (2.21, 2.33 and 2.24%, respectively). Moisture contents in oleoresin products were also highest in orange followed by mandarin then mango peels oleoresin. While, the pH value was the highest in commercial mango compared to mandarin and orange products (4.20, 3.91 and 3.88, respectively) than natural oleoresin products. In parallel, pH value was decrease gradually in mango, orange then mandarin peels oleoresin (4.28, 4.10 and 4.02), respectively. In contrast, titratible acidity was increase gradually in mango, mandarin then orange peels oleoresin (0.41, 0.38 and 0.37, respectively) formulas.

Table (3): Physico-chemical properties of mango, orange and mandarin peels oleoresin formulas compared to commercial products (On dry weight basis).

Items	Moisture (%)	pH	Total titratible acidity (as citric acid)	Total sugars (%)	Total soluble solid (^{o}Brix)
Commercial	2.60± 0.06	4.20±0.07	0.42±0.01	80.70±0.09	96.00±0.19
Mango formula	2.21±0.04	4.28±0.10	0.41±0.02	78.10±0.12	93.20±0.21
Commercial	2.54±0.05	3.88±0.03	0.38±0.02	82.00±0.07	97.36±0.21
Orange formula	2.33±0.04	4.10±0.09	0.37±0.01	75.13±0.10	٩٣.40±0.24
Commercial	2.52±0.04	3.91±0.08	0.39±0.02	٨١.55 ±0.011	٨٩.46±0.18
Mandarin formula	2.24±0.04	4.02±0.10	0.38±0.01	75.32±0.16	٨٧.13±0.23

Values are means of triplicates ± Standard deviation

Total sugars content in commercial mango, orange and mandarin products were the highest (80.70, 82.00 and 81.55%, respectively) compared to oleoresin formulas (78.10, 75.13 and 75.32%, respectively), this may due to the addition of artificial color and aroma, thus be compensated by sugar. Also, total soluble solid (TSS) was higher in mango, orange and mandarin commercial products (96.00, 97.36 and 89.46, respectively) than oleoresin products due to the last products contained natural antioxidants components and essential oil compounds.

Generally, the physical properties such as moisture content, pH, titratible acidity, total sugar and Brix of oleoresin mango, orange and mandarin peels were related to ease of reconstitution.

The bioactive components of mango, orange and mandarin fresh peels oleoresin were tabulated in Table (4). The antioxidative activity of mandarin peels oleoresin must be retained for the observed high phenolic compounds content (50.51±2.41mg/g) and vitamin C (1.30±0.06 mg/g) as mentioned in Table (4). While, total flavonoids contents (5.66±0.21 mg/g) for mango peels oleoresin showed the second level for tested peels oleoresin oxidative activates, also mango oleoresin was high in carotenoids (12.53±0.43 mg/g). Mandarin which has the significant content of essential oil (1.92±0.23 g/100g) comparing to orange and mango oleoresin peels, showed nine terpenoids in observable contents (Table 5).These data were comply to Magda *et al.* (2008), they found that, mandarin peel had the highest in total phenol content as compared to orange peels (Magda *et al.,* 2008). Ghasemi *et al.* (2009) reported the total phenolic contents of *Citrus reticulate* varieties peel powder in the range of 104.2-172.1 mg/gallic acid.

Table (4): Antioxidant components of mango, orange and mandarin peels oleoresins (mg/g)

Items	Mango	Orange	Mandarin
Total phenols	22.9±1.09	13.64±0.44	50.51±2.41
Total flavonoids	5.66±0.21	5.11±0.47	1.65±0.02
Carotenoids	12.53±0.43	9.06±0.12	2.14±0.21
Vitamin C	1.02±0.03	1.22±0.10	1.30±0.06
Essential oil (g/100g)	0.05±0.01	0.36±0.07	1.92±0.23

Values are means of triplicates ± Standard deviation

Essential oil fractions

The essential oil fractions of mango, orange and mandarin peels oleoresin were fractionated by GC-MS, the result was showed in Table (5).

Table (5): Essential oil fractions in mango, orange and mandarin peels oleoresins (%)

Items	Mango	Orange	Mandarin
α- Thruiene	-	0.27	0.61
α-Pinene	12.82	0.53	0.98
Camphene	0.46	0.84	0.18
Subinene		0.35	0.29
β-Pinene	1.54	1.44	0.68
Myrcene	2.30	0.82	1.33
α-Terpinene	0.33	0.75	0.96
ρ-Cymene	0.38	0.26	0.65
Limonene	2.84	85.80	52.67
1,8-Cineol	-	-	13.31
Z- β-Ocimene	0.13	-	-
E-β-Ocimene	-	0.10	6.52
γ-Terpinene	0.26	0.38	11.02
Cis-Sabinene hydrate	-	0.32	0.18
Octanol	-	0.09	1.12
Terpinolene	3.14	0.98	0.13
Linalool	-	0.43	0.71
Camphor	-	3.62	0.44
Terpinene-4-ol	-	0.28	0.02
α-Terpinol	-	0.36	1.06
citronellol	-	0.14	0.05
Nerol	-	-	0.08
Carvacol	-	0.16	0.10
A-Terpinyl acetate	-	0.12	0.59
Geranyl acetate	-	0.11	0.28
Germacerene D	-	0.11	0.17
Valencene	0.27	0.13	0.18
Hexadecanol	0.28	-	-
2-Heptadecanoate	0.12	-	-

Mango peels oleoresin has higher content in α-pienene, terpinolene, myrcene and β-pienene than other fractions (12.82, 3.14, 2.30 and 1.54%, respectively) Also, the major compound in orange then mandarin peels oleoresin was limonene (85.80 and 52.67%, respectively). Camphor content was higher content in orange than mandarin peels oleoresin (3.62 and 0.44%, respectively). The most important aroma characteristic in mandarin peels oleoresin were 1,8-cineol (13.31%) followed by γ-terpinene (11.02%) then E-β-ocimene (6.52%).

Conclusively, mandarin followed by mango then orange peels oleoresins contained several essential oil compounds. It's worth to say that the chemical structure has valuable effect at aroma for the effective group and their location on the structure. That gives idea to the valuable activity with the compound concentration in the essential oils.

This data were adapted by Engel and Tressl (1983), who found that Egyptian mango peels cultivar typified by myrcene and limonene. While, limonene was the one most abundant monoterpene, representing in orange (Hashem *et al.,* 2014). Mohamed *et al.* (2014) also, identified components were thymol, α-pinene and γ-terpinene and linalool in mandarin volatile oils.

Antioxidant activities

The antioxidant activities of different mango, orange and mandarin peels oleoresin are presented in Table (6). The antioxidant activity for all oleoresin increase gradually by increase oleoresin concentration from 20 to 100 mg oleoresin in different materials. Orange peels oleoresin has the highest antioxidant activity (from 54.20 to 73.00%) in gradual concentrations followed by mango peels oleoresin (from 46.24 to 55.82%) then mandarin peels oleoresin (from 33.92 to 52.02%). These data may be due to that orange peels oleoresin is rich in limonene and camphor, also carotenoids, flavonoids and vitamin C.

Table (6): Antioxidant activities (%) in different mango, orange and mandarin peels oleoresin concentration (DPPH method)

Oleoresin/ mg	Mango	Orange	Mandarin
20	46.24±4.54	54.20±5.20	33.92±4.32
40	48.50±5.20	58.55±7.43	38.24±3.25
60	49.08±4.25	66.53±6.97	43.54±5.00
80	52.95±7.34	70.62±6.32	48.11±4.85
100	55.82±6.55	73.00±9.64	52.02±6.23

Values are means of triplicates ± Standard deviation.

Organoleptic evaluation

The organoleptic evaluations of oleoresins from mango, orange and mandarin peels are shown in Tables (7, 8 and 9).

Results in Table (7) revealed no significant difference in color parameter between formulas contained to 80 and 100 mg mango peels oleoresin and commercial formula (8.95, 9.16 and 9.30, respectively). The maximum score for aroma and flavor were found in mango peels oleoresin products contained 80 and 100 mg/100 g (9.15 and 9.32; 9.22 and 9.35, respectively), whereas the minimum score was observed in same products which contained 20 and 40 mg/100 g mango peels oleoresin. While, in Table (7) showed no significant difference between all mangos peels oleoresin formulas to commercial products in sweetness and consistency.

Table (7): Organoleptic evaluation mango peels oleoresin products (mg/100g) compared with commercial products

Items	Color	Sweetness	Aroma	Flavor	Consistency	Overall acceptability
Commercial	9.30± 0.24^{a}	9.25±0.12^{a}	8.92±0.26^{a}	8.20±1.25^{ab}	9.50±0.58^{a}	9.25±0.99^{a}
20	7.22±0.76^{c}	8.94±0.20^{a}	7.36±0.23^{c}	7.45±2.05^{c}	9.45±0.43^{a}	8.36±1.02^{ab}
40	7.98±0.92^{b}	8.96±0.22^{a}	8.40±0.53^{ab}	7.99±1.98^{c}	9.44±0.23^{a}	8.55±1.43^{ab}
60	8.00±1.02^{b}	9.12±0.28^{a}	8.86±0.70^{ab}	8.54±0.88^{ab}	9.43±0.38^{a}	8.90±0.86^{ab}
80	8.95±0.72^{a}	9.15±0.24^{a}	9.15±0.17^{a}	9.22± 0.34^{a}	9.42±0.41^{a}	9.40±0.53^{a}
100	9.16±0.43^{a}	9.22±0.17^{a}	9.32±0.24^{a}	9.35±0.57^{a}	9.46±0.55^{a}	9.42±0.66^{a}

Values are means (10 panelists) ± Standard deviation
Means within a column (for each variable) marked with letters are significantly different (P<0.05).

The score for overall acceptability of mango peels oleoresin ranged between 8.36 to 9.42 in all formulas compared with commercial formula, but formula contained 80 and 100 mg/100 g mango peels oleoresin were the best.

In 80 and 100 mg concentrates, there are non-significant different between all attributed tested. The overall acceptability, there are non-significant different between commercial formula and formulas containing 80 or 100 mg/100 g.

There is gradually increase in score of color, aroma, flavor and overall acceptability in formulas containing 60, 80 and 100 mg/100 g orange peels oleoresin observed in Table (8). While, formula containing 100mg orange peels oleoresin /100 g was the best in all sensory parameters. The same observation in sweeteners and consistency parameters were not significant difference between all orange peels oleoresin formulas to commercial formula.

Table (8): Organoleptic evaluation of orange peels oleoresin products (mg/100g) compared with commercial products

Items	Color	Sweetness	Aroma	Flavor	Consistency	Overall acceptability
Commercial	9.32±1.20^{a}	9.15±0.16^{a}	9.23±1.02^{a}	8.92±1.43^{a}	9.46±0.52^{a}	9.30±1.22^{a}
20	8.24±0.99^{b}	8.84±0.23^{a}	7.88±0.74^{b}	7.98±1.20^{c}	9.48±0.33^{a}	8.88±0.43^{b}
40	8.55±1.13^{b}	8.91±0.32^{a}	8.25±0.92^{ab}	8.40±1.08^{b}	9.42±0.20^{a}	8.92±0.81^{b}
60	9.11±0.82^{a}	9.08±0.30^{a}	9.18±0.85^{a}	9.18±0.98^{a}	9.46±0.41^{a}	9.11±0.90^{a}
80	9.25±0.63^{a}	9.10±0.22^{a}	9.22±0.33^{a}	9.25±0.83^{a}	9.50±0.37^{a}	9.20±0.77^{a}
100	9.30±1.00^{a}	9.20±0.14^{a}	9.30±0.60^{a}	9.28±0.80^{a}	9.51±0.52^{a}	9.32±0.82^{a}

Values are means (10 panelists) ± Standard deviation
Means within a column (for each variable) marked with letters are significantly different (P<0.05).

A gradually increases in sensory parameters in formulas containing 60, 80 and 100 mg mandarin peels oleoresin/100g, respectively (Table 9). The maximum score for overall acceptability was observed in formula contained 100mg of mandarin peels (9.36), then formulas contained 80, 60 and 40 mg mandarin peels oleoresin (9.36, 9.29 and 9.21) respectively, whereas, the minimum score for overall acceptability showed in formula containing 20 mg mandarin peels oleoresin formula.

Table (9): Organoleptic evaluation mandarin peels oleoresin products (mg/100g) compared with commercial products

Items	Color	sweetness	Aroma	Flavor	Consistency	Overall acceptability
Commercial	9.40±1.00^{a}	9.24±0.11^{a}	9.30±1.02^{a}	9.00±1.20^{a}	9.51±0.40^{a}	9.34±1.30^{a}
20	8.42±0.62^{b}	8.72±0.34^{ab}	8.02±0.82^{b}	8.03±1.43^{b}	9.22±0.83^{a}	8.76±1.53^{ab}
40	8.69±0.85^{b}	8.90±0.80^{ab}	8.55±0.64^{ab}	8.82±0.85^{ab}	9.32±0.90^{a}	9.05±0.84^{a}
60	9.18±0.77^{a}	9.11±0.64^{a}	9.26±0.50^{a}	9.10±0.62^{a}	9.41±0.73^{a}	9.21±0.64^{a}
80	9.30±1.02^{a}	9.20±0.88^{a}	9.50±0.73^{a}	9.21±0.85^{a}	9.43±0.81^{a}	9.29±0.70^{a}
100	9.43±0.93^{a}	9.26±0.69^{a}	9.53±0.98^{a}	9.26±1.00^{a}	9.39±0.66^{a}	9.36±0.63^{a}

Values are means (10 panelists) ± Standard deviation
Means within a column (for each variable) marked with letters are significantly different (P<0.05).

Volatile oil fractions reflect to organoleptic evaluation and consumer attribute. Generally, flavor is the blend of taste and smell perceptions, it is judged to accept food or not. Aroma in mandarin showed the highest one and that due to the quantity of volatile oil (Table 4) and quality of some volatile oil compounds (Table 5). Also, mango and orange gave the highest evaluation in sensory acceptability has been shown for the aroma and flavor results may due to the highest contents in flavonoids and carotenoids and volatile oil components.

CONCLUSION

Mango, orange and mandarin peel by-products contain many nutritionally and economically valuable components. The by-products from processing industries have significant exploitation potential to produce oleoresins. Therefore, it is capable of offering low-cost nutritional dietary supplement for lower income masses. Economic valorization of peel by-products could readily be realized through oleoresins flavour utilization instead of synthetic flavours.

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الراتنجات الزيتية لقشور المانجو والبرتقال واليوسفي لإعداد مشروبات نكهة طبيعية وصحية

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تعتبر قشورالفاكهة مصدر طبيعي للمواد المضادة للأكسدة والنكهة. فمخلفات قشور المانجو والبرتقال واليوسفي تحتوي على العديد من المكونات ذات القيمة الغذائية والاقتصادية التي يمكن استغلالها كقيمة مضافة لصناعة المشروبات. أجريت هذه الدراسة على إنتاج مشروبات نكهه سريعة التحضير من أليوريزين لقشور المانجو والبرتقال واليوسفي بتركيزات ٢٠ و ٤٠ و ٦٠ و ٨٠ و ١٠٠ ملليجرام/١٠٠ جرام مقارنة بمنتجات المشروبات المتداولة تجارياً. تم إختبار هذه الخلطاتمن ناحية خصائصها الفيزيائية والكيميائية كذلك محتواها من مضادات الأكسدة والتعرف علي محتويات وتفريد المركبات الطيارة ثم تقييمها حسياً.وقد دلت النتائج المتحصل عليها إلى أن محتوي الرطوبة في منتجات أوليوريزين كانت أعلى في البرتقال تليها اليوسفي ثم المانجو. في حين كانت قيمة رقم الأس الهيدروجيني هي الأعلى في المانجو التجاري مقارنة مع منتجات اليوسفي والبرتقال (٤.٢٠ و ٣.٩١ و ٣.٨٨ على التوالي) من منتجات الأوليوريزين الطبيعية. في حين أن المحتوى الكلي للسكريات في منتجات المانجو والبرتقال واليوسفي التجارية كان الأعلى (٨٠.٧٠، ٨٢.٠٠ و ٨١.٥٥٪ على التوالي) مقارنة مع خلطات الأولوريزين (٧٨.١٠، ٧٥.١٣ و ٧٥.٣٢٪ على التوالي). لوحظ النشاط المضاد للأكسدة لأليوريزين قشور اليوسفي يرجع لإرتفاع محتواها من المركبات الفينولية (٥٠.٥١ ±2.41 ملليجرام/جرام) وفيتامين ج (١.٣٠ ± ٠.٠٦ ملليجرام/جرام). في حين أن محتوى الفلافونيدات الكلية (٥.٦٦ ± ٠.٢١ ملليجرام/جم) لأوليوريزين قشور المانجو والتي جاءت في المرتبة الثانية للنشاط المضاد للأكسدة، كما كان أوليوريزين قشور المانجو مرتفع في محتواه من الكاروتينات (١٢.٥٣ ± ٠.٤٣ ملليجرام/جرام).كما لوحظ أن أليوريزين قشور اليوسفي ذات محتوى مرتفع من الزيت الطيار (١.٩٢ ± ٠.٢٣ جرام/١٠٠جرام وزن طازج) مقارنة بأليوريزين قشور البرتقال والمانجو. تبين أن محتوي أليوريزين قشور المانجو أعلى في مركبات α-بينين، تيربينولين، ميرسين وβ - بينين من المركبات الأخرى (١٢.٨٢، ٣.١٤، ٢.٣٠ ، ١.٥٤٪ على التوالي)، أيضا كان المركب الرئيسي في الراتنجات الزيتية لقشور البرتقال ثم اليوسفي هو الليمونين (٨٥.٨٠ ، ٥٢.٦٧٪على التوالي). محتوى الكامفور أعلى في الراتنجات الزيتية لقشور البرتقال من اليوسفي (٣.٦٢ ، ٠.٤٤٪ على التوالي). وكانت أهم سمة للرائحة في أليوريزين قشور اليوسفي ١-٨ سينيول (١٣.٣١٪) تليها γ–تربينين (١١.٠٢٪) ثم E-β أوسيمين (٦.٥٢٪). أليوريزين قشور البرتقال لديه أعلى نشاط لمضاد للأكسدة بطريقة DPPH (من ٥٤.٢٠ إلى ٧٣.٠٠%) يليها أليوريزين قشور المانجو (من ٤٦.٢٤ إلى ٥٥.٨٢%) ثم أليوريزين قشورااليوسفي (من ٣٣.٩٢ إلى ٥٢.٠٢%). تعزي تلك النتائج لغني أوليورزين قشور البرتقال بالليمونين والكامفور كذلك الكاروتنويدات والفلافونيدات وفيتامين ج. الرائحة في أليوريزين اليوسفي أظهرت أعلى مستوي نظراً لكمية الزيت الطيار وجودة بعض المركبات الطيارة. أيضا أعطت خلطات أليوريزين قشور المانجو والبرتقال أعلى قيم من حيث القبول الحسي الواضح عن نتائج الرائحة والنكهة، وهذا قد يرجع ذلك إلى ارتفاع محتوياهما من الفلافونويدات والكاروتنويدات ومكونات الزيوت الطيارة. ولهذا فان استخدام أوليورزين المانجو والبرتقال واليوسفي كمنكهات طبيعية أفضل عن المنكهات التجارية الصناعية أو المخلقة.