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Utilization of Red Carrot Roots (*Daucus carota* L.) By-products As A Source of Natural Pigments

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Abstract

Nowadays growing demand for eco-friendly/non-toxic colorants, specifically for health sensitive applications such as coloration of food. Recently, colors derived from natural sources for these applications have emerged as an important alternative to potentially harmful synthetic colors. Natural color is one of the crucial factors for the consumers palatability of any processed foods. The potential sources of coloring pigment anthocyanin is present in red carrot pomace material. Extraction of these natural colors and using as alternative natural red colorants in jam is very important. Chemical composition of red carrot pomace powder was determined**.** Moisture, crude protein and ash content of dried red carrot pomace were 10.14, 4.86 and 5.89 %, respectively. Meanwhile, it contained higher values of carbohydrates and crude fiber.

As for, minerals content it was observed that potassium and sodium content of red carrot pomace was found in larger amounts. On the other hand, the total phenolic compounds and total flavonoids were 10.08 and 5.15 mg/g, respectively. As well as, antioxidant activity was 86.48%. HPLC separation indicated that there were two major anthocyanin components namely cyanidin 3-glucoside which represented to be 270.62 µg /ml, meanwhile the other one was delphinidin 46.39 µg /ml. The effect of pH and temperature on anthocyanin stability was studied and the results indicated that its stability was more pronounced at acidic pH values (1.0 to 5.0), while, the highest degradation occurred at pH 7. Moreover, the anthocyanin extract was more stable at temperatures 40 and 60°C after holding for 30 to 120 min. Consequently, the holding of pigments at 80 and 100°C for 30 to 120 min. caused reduction in the remaining of anthocyanin. Concerning, the addition of anthocyanin extract with 1% was more palatable and recorded the highest sensory quality standards compared to other concentrations followed by the addition 0.5% of it. It could be noticed that the effect of storage on color intensity of guava jam and the rate of decrement in color intensity were higher in samples stored at ambient temperature compared to same at 4°C. Finally, it could be concluded that, red carrot pomace is considered as a very important good source of anthocyanin which recorded 130.54 mg/100g on dry weight basis.

Keywords: *Red carrot pomace, chemical composition, anthocyanin, HPLC, pH, heat stability and guava jam.*

Introduction

Fruits and vegetables waste and their by-products are remaining in great amounts during industrial processing and hence represent a serious problem, as they exert harmful impact on the environment. So, they need to be managed or they can be utilized (Duda-Chodak and Tarko, 2007). Generally, agro-industrial wastes have been used extensively as animal feeds or fertilizers. Recent reports show development of high value products (such as cosmetics, natural colorants, foods and medicines) from agro-industrial by-products (Rudra *et al*., 2015).

Carrot (*Daucus carota* L.) is an important root vegetable. The first cultivated carrot types were purple or violet. Later yellow and orange types were derived from this anthocyanin type by selection process (Banga, 1984). Purple carrot (or black carrot as it sometimes referred to) is a natural food colorant, offering a final color which can vary from deep violet to bright red. Carrot usually used for juice production, and there is a steady increase in carrot juice consumption. In the juice industry, thousands of tons of carrot pomace are produced after the juice extraction (Mazza and Miniati, 1993 and Schieber *et al*., 2001).

Although, the natural colorants were eco-friendly/non-toxic colorants, they have some disadvantages compared to synthetic ones, including higher cost in-use and lower stability. However, people have increasingly avoided synthetic colorants, preferring natural pigments, which are considered to be harmless or even healthy as antioxidants (Henriette, 2009).

Anthocyanins considered as the more important plant water-soluble pigments and visible to the human eye. They belong to the widespread class of phenolic compounds collectively named flavonoids. The flavonoid subgroup contains the anthocyanin's, one of the most broadly naturally source of colorants. On the anthocyanin structure (Figure 1) there are 7 positions labeled R. R basically means that it can be occupied by almost any organic group like a methoxyl group, sugar, and the number of R that are occupied by specific substitutions would determine the color of the anthocyanin (Kong *et al*., 2003) Furthermore, they are characterized by a wide spectrum of color tones, ranging from orange through red, to purple and blue, depending on the molecular structure and pH value (Dorota and Janusz, 2007). They are harmless and easy incorporation in aqueous media, which makes them interesting for its use as natural water-soluble colorants (Pazmino-Duran *et al*., 2001).

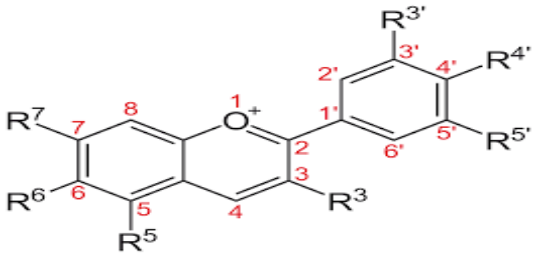

Fig. 1. Structure of anthocyanin

Anthocyanins isolated from natural sources are highly unstable and susceptible to degradation, which leads to loss of bioactivity and color fading. Factors affecting the rate of degradation include light, tempera-

ture, pH, oxygen, enzymes, the presence of pigments and water activity (Chung *et al*., 2016 and Weber *et al*., 2017). Accordingly, this investigation was planned to evaluate the stability of anthocyanins derived from red carrot pomace under different conditions like temperature and pH, as well as, make value-added products.

Materials and Methods

Materials

Raw Materials

Red carrot pomace (*Daucus carota* L.) used in this study was obtained from the factory of jam and juices (in Food Technology Research Institute), Giza, Egypt.

Most chemicals (analytical grade) were purchased from El-gomhouria pharmaceuticals Co., Cairo, Egypt. 2.2-diphenyl-1-1picryl-hydrazyl (DPPH), Folin-Ciocalteu reagent, gallic acid, quercitin and HPLC grade solvents were obtained from Sigma-Aldrich Chime, Steinheim, Germany.

Methods

Preparation of carrot pomace

Red carrot pomace was dehydrated at 50 ± 1°C in a drying oven for 36 hours. The dried red carrot pomace was grinded and kept individually in polyethylene bags and stored in refrigerator at 5 ± 1°C until used.

Analytical Methods

Chemical composition

Moisture, ash, protein, fat and crude fibers contents were determined according to the methods described in the A.O.A.C. (2012). Minerals content was determined after dry ashing according to the method described in the A.O.A.C. (2012), using atomic absorption amanitas (Perkin – Elmer, Model 3300, USA).

Determination of total phenolic compounds

Total phenolic compounds content was determined using Folin-Ciocalteu reagent according to the method described by Maurya and Singh (2010). Gallic acid was used for calibration curve. Results were expressed as mg gallic acid (GAE)/g.

Determination of total flavonoids

Total flavonoids content was determined according to the method described by Jia *et al*. (1999). Quercetin was used for calibration curve. Results were expressed as mg quercetin/g.

Determination of antioxidant activity

The antioxidant activity of samples was determined by the 2, 2'-Diphenyl-1- picrylhydrazyl (DPPH) radical scavenging activity according to the colorimetric method of Brand-Williams *et al*. (1995). The percentage inhibition of the DPPH radical by the samples was calculated according to the formula of Yen and Duh (1994).

Inhibition% = (Ac (0) – AA(t))/Ac (0) × 100

Where:

Ac (0) is the absorbance of the control at time = 0 min.

AA (t) is the absorbance of the antioxidant at time =1hr.

Determination and identification of anthocyanins

Total anthocyanins were determined according to the method described by Ranganna (1977). Anthocyanins were fractionated and identified by HPLC (Agilent), model-LC 1100 series according to the method of Drust and Wrolstad (2001).

Extraction of natural red pigments from red carrot pomace

Natural red pigments were extracted according to the method described by Francis (2000). 200 g of the pomace were mixed with 1 L of acidified water 4% citric acid at 4±1°C and left for 24 hours. All filtered extracts were concentrated under vacuum by a rotary evaporator at 50±1°C. All previous natural red pigments concentrates were preserved at 4±1°C till analysis.

Stability of natural red pigment extracts.

Effect of pH

A preliminary study was conducted to test the stability of anthocyanin extract at different pH ranged from 2.0 to 10.0 for 30 min and then percentage of color loss was calculated.

Effect of temperature

The heat stability of anthocyanin extract was determined according to the method described by Fernández-López *et al*. (2013). A preliminary study was conducted to heat tolerance of anthocyanin extract at different temperature ranged from (30, 40, 60, 80 and 100± 1°C) for 30, 60, 90 and 120 min, then, the percentage of color loss was calculated.

Utilization of separated natural pigments as natural colorant of Jam preparation.

Ripe guava fruits were washed, hand peeled, blanched in boiling water for 5 minutes, then divided into four equal parts as follows: The first 1000g of blanched guava, 830 g sucrose and citric acid (0.02%) were added. Cooking continued until reaching 70% total soluble solids. Finally, the anthocyanin extract (0.5, 1.0 and 1.5 %) were added then, the jam was packed in glass jars according to Mattuk. (1998).

Effect of storage on color stability

Color intensity of guava jams was determined as described by Fuleki and Francis (1968) at the zero time and periodically and at intervals of one week during storage for 12 weeks at ambient temperature (25 ± 1°C) and 4± 1°C.

Sensory Evaluation

Sensory attributes (color, taste, odor, texture and overall palatability) of guava jam were conducted by more than ten panelists (chosen by random) in the Food Technology Research Institute, according to the method of Lindley *et al*. (1993).

Statistical Analysis

The statistical analysis was carried out using one-way analysis of variance (ANOVA) under significant level of 0.05 for the whole results using the statistical program CoStat (Ver. 6.400) and data were treated as complete randomization design according to Steel *et al*. (1997). To ascertain the significant among means of different samples, LSD test was applied.

Results and Discussion

Chemical composition of red carrot pomace powder.

Chemical composition of red carrot pomace powder was recorded in Table (1). The obtained results show that moisture, crude protein and ash content of dried red carrot pomace were 10.14, 4.86 and 5.89 %, respectively. Meanwhile, red carrot pomace powder contained higher value of carbohydrates and crude fiber (65.8 and 11.91% respectively). However, it contained small amount

from crude fat. The obtained results are in agreement with those reported by Afify *et al*. (2013) ,who recorded that crude protein, total lipid, ash and crude fiber contents were 6.86, 1.48, 6.24 and 11.80%, respectively.

Table 1. Chemical composition of red carrot pomace (on dry weight basis).

Constituents %	Red carrot pomace	L.S.D ≤ 0.05
Moisture	10.14^{a}±0.33	0.67
Ash	5.89^{a} ±0.29	0.50
Crude protein	4.86^{c} ±0.18	0.69
Crude Fat	1.40^{c} ±0.33	0.70
Crude fiber	11.91^{b}±0.25	1.20
Total carbohydrates	65.8^{c} ±0.31	0.69

Values are mean ±SD of three replicates. Different letters in each column show significant difference at P≤ 0.05.

Minerals content of red carrot pomace.

The data presented in Table (2) show the minerals content of red carrot pomace. Calcium, nitrogen, phosphorus, potassium, sodium, manganese, copper, zinc and iron were detected. The obtained results indicated that potassium and sodium content of red carrot pomace was found in larger amounts (2340 and 2100 mg/100g) followed by calcium (1030 mg/100g). Meanwhile, nitrogen and phosphor content were found in moderate amounts (220 and 124 mg/100g). In addition, red carrot pomace has the lowest content for iron, copper and zinc. These results are higher than those reported by Shyamala and Jamuna (2010) who found that, carrot pomace had higher content of phosphorus and calcium. The mineral content of plants can be significantly influenced by variety, location, and environmental conditions (Rao, 1996).

Table 2. Minerals content (mg/100g) of red carrot pomace (on dry weight basis).

Sample	Ca	N	P	K	Na	Mn	Cu	Zn	Fe
Carrot pomace	1030	220	124	2340	2100	1.25	3.45	2.35	20.5

Bioactive compounds, antioxidant activity and anthocyanin content of red carrot pomace.

Some bioactive compounds namely, polyphenols, flavonoids contents and antioxidant activity, as well as, anthocyanin content were determined and the results are presented in Table (3). Date show that total phenolic compounds and total flavonoids were 10.08 and 5.15 mg/g. As well as, antioxidant activity of red carrot pomace methanolic extract was 86.48%. These results are in agreement with those reported by Borowska *et al*. (2017), who found that the level of total phenolic was 10.13 mg/g on dry weight basis.

On the other hand, red carrot pomace is considered as a good source for anthocyanin which amounted to 130.54 mg/100g on dry weight basis. These results are in agreement with that obtained by Mazza and Miniati (1993).

Table 3. Bioactive compounds and anthocyanin content of red carrot pomace

Sample	**Total phenolic compounds** (as Gallic acid) (mg/g)	**Total flavonoids** (mg/g)	**Antioxidant activity** % (as DPPH)	**Total anthocyanin** (mg/100g)
Carrot pomace	10.08	5.15	86.48	130.54

Identification of anthocyanins for red carrot pomace by HPLC.

Anthocyanins pigments extracted from red carrot pomace were separated and identified by HPLC are shown in Fig. (2) and Table (4). Spectral measurement and HPLC separation indicated that there are two major anthocyanin components for red carrot pomace namely cyanidin 3-glucoside which represented to be 270.62 µg /ml, meanwhile the other one was delphinidin 46.39 µg /ml. These results were different with Dyrby *et al*. (2001), Mc-Doug *et al*. (2007) and El- Massry *et al*. (2013). They recorded that, anthocyanidin was the only aglycone and only two different anthocyanins were present in the extract cyanidin-3-diglucoside-5-glucoside and cyanidin 3, 5 diglucoside in red cabbage. This varied results may be affected by many factors, such as variety of raw materials, growing conditions, climate and the extraction process itself (parameters and the type of solvent) and the method of marking and identification (Wiczkowski *et al*., 2013).

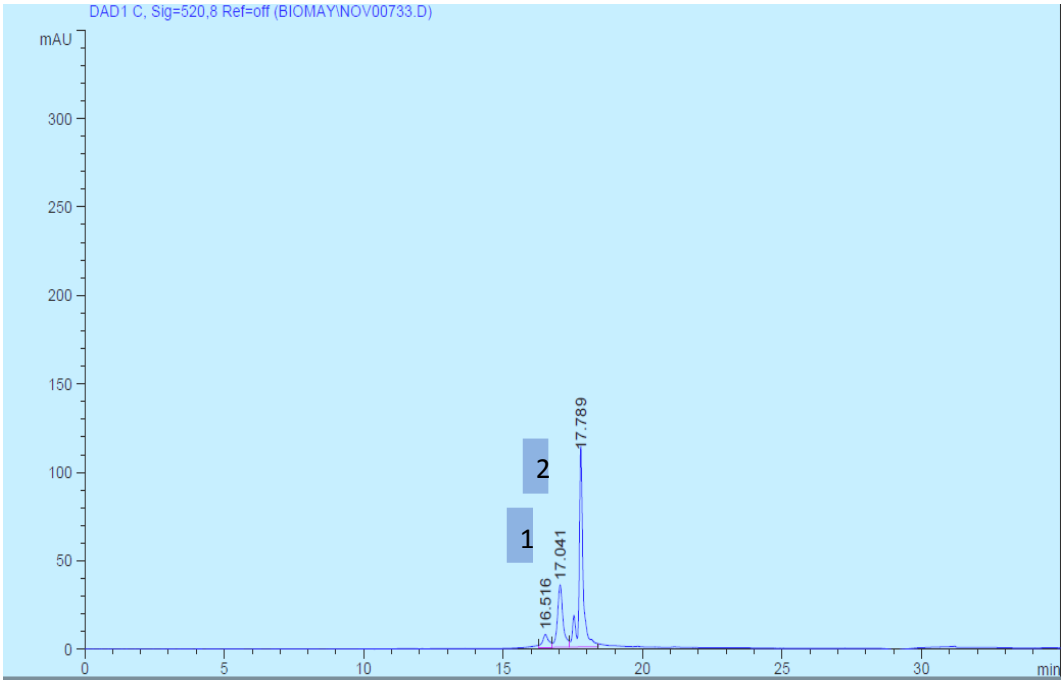

Fig. 2. Identification of anthocyanin pigment compounds extracted from red carrot pomace.
1 - Delphinidin 2 – Cyanidin 3-Glucoside

Table 4. Identification of anthocyanins from red carrots pomace by HPLC

Std.	Tr	Inj	Area Std.	Area Sp.	µg /ml
Delphinidin	16.5	2.3	1115.849	112.5301	46.39
Cyanidin 3-glucoside	17.1	5	1803.453	488.0485	270.62

Area Std **:Area Stander** Area Sam.**: Area sample** Inj**: injection volume**

Effect of pH on retention of anthocyanin pigment extracted from red carrot pomace.

The effect of different pH values on retention of anthocyanin pigments derived from red carrot pomace was determined using the pH-differential method at nine different pH ranged from 2.0 to 10.0 and the results are presented in Table (5). The highest OD value at 520 nm. observed at pH 2 and 3 (1.076 and 1.042, respectively) while, at pH 7 recorded the lowest OD (0.621). As well as, increasing of pH values from 2 to 3 caused 23.79% little degradation of anthocyanins content. However, the degradation of color was not significant till pH 5, meanwhile, the degradation of color reached to 28.99 and 42.28% at pH 6 and 7, respectively. So, it could be observed that the stability of anthocyanins pigment was more pronounced at acidic pH values (1 to 5), While, the highest degradation was occurred at pH 7. These results are in agreement with those reported by Stintzing *et al*. (2002) found that in acidic media, anthocyanin showed red color, while as the pH progressively increased in alkaline side, they became more blue. Anthocyanins are stable at low pH. This may be due to the structure of the anthocyanins (red circle) is called flavylium cation, at low pH the cyanidin molecule is protonated and forms a positive ion or cation, as the pH increases the molecules become deprotonated, at high pH the molecule forms a negative ion or anion (Jackman and Smith, 1992 and Brouillard and Bangles, 1994).

Table 5. Effect of pH on retention of anthocyanin pigment extracted from red carrot pomace.

pH	Anthocyanins ʎ=520 nm	Remained of anthocyanin%	Degradation of anthocyanin%
2	1.076	100.0	0.00
3	1.042	96.84	3.16
4	0.897	83.09	16.91
5	0.818	76.21	23.79
6	0.764	71.01	28.99
7	0.621	57.72	42.28
8	0.681	63.29	36.71
9	0.810	75.08	24.92
10	0.850	79.00	21.00

Effect of temperature degrees on retention of anthocyanin pigment extracted from red carrot pomace.

Temperature is a one factor that affects the stability of anthocyanin. Four different temperatures ; 40, 60, 80 and 100 °C for 30, 60, 90 and 120 min were used to evaluate the effect of temperature on retention of anthocyanin pigment extracted from

red carrot pomace. The results (Table 6) showed higher level of degradation of anthocyanin at 80 and 100 °C after holding for 90 and 120 min (10.37 and 11.55 % & 18.74 and 24.78%, respectively) indicating that higher temperature (80 and 100 °C) should be avoided in the processing, storage and usage of anthocyanin extract from red carrot pomace. However, the anthocyanin extract is more stable at temperatures 40 and 60°C after holding for 30 to 120 min. Consequently, the holding of pigments at 80 and 100 °C for 30 to 120 min caused reduction in the remaining of anthocyanin from 93.47 to 88.45 and 91.45 to 75.22 %, respectively. Furthermore, anthocyanin pigments of red carrot pomace recorded the highest content at 40 °C for 30 min (111.36 mg/100g) and the lowest content at 100 °C for 120 min (86.27 mg/100g). These results are in accordance with those reported by Assous *et al*. (2014) who found that the remaining of anthocyanin were being 92.0% of the total anthocyanin and the highest degradation at 100°C was 8.0 %. This is degradation of monomeric anthocyanins increased with increasing temperature due to the destruction color during heating is much more rapid when oxygen is present. Also, thermal degradation leads to the formation of the chalcone and its subsequent yield of several degradation products that condense to form complex brown polymeric compounds known as melanoid in pigments (Piffaut *et al*., 1994).

Table 6. Effect of temperature on retention % of anthocyanin pigment extracted from red carrot pomace

Temperature °C / Time min.		Amount (mg/100g)	Remained of anthocyanin %	Degradation of anthocyanin%
40	**30**	111.36	97.09	2.91
	60	111.11	96.88	3.12
	90	110.75	96.56	3.44
	120	108.18	94.32	5.68
60	**30**	111.11	96.88	3.12
	60	109.68	95.63	4.37
	90	108.23	94.36	5.64
	120	107.72	93.92	6.08
80	**30**	107.21	93.47	6.53
	60	104.36	90.99	9.01
	90	102.8	89.63	10.37
	120	101.45	88.45	11.55
100	**30**	103.49	91.45	8.55
	60	104.89	90.23	9.77
	90	93.2	81.26	18.74
	120	86.27	75.22	24.78

Sensory evaluation of guava jam with natural anthocyanin extract

Four different guava jams were prepared with different levels of natural red extract (0.5, 1.0 and 1.5 %, respectively). These blends were sensory evaluated for taste, color, consistency, odor, palatability and overall acceptability. The data were statistically analyzed as shown in Ta-

ble (7). Addition of anthocyanin extract with 1% was more acceptable and recorded the highest scores for color and overall (9.33 and 44.33) compared with other concentrations followed by the addition 0.5%. On the other hand, the lowest score was given to the control. The above-mentioned data are different with those reported by Mattuk (1998) and El- Massry *et al*., (2013). They found that the addition of natural red colorant extracted from mulberry fruits with 1.5 % concentration gave very palatable and popular syrup.

Table 7. Sensory evaluation of guava jam with natural anthocyanin extract.

Treatments*	Color	Taste	Odor	Texture	Palatability	Over all acceptability
NO_1	5.5^{d}±0.50	5.83^{b}±0.52	6.00^{b}±1.00	6.00^{b}±0.50	6.16^{c}±0.29	29.66^{b}±1.25
NO_2	8.00^{b}±0.29	8.33^{a}±0.57	8.66^{a}±1.00	8.00^{a}±0.29	8.33^{b}±0.57	41.83^{a}±1.60
NO_3	9.33^{a}±0.58	8.66^{a}±1.15	9.00^{a}±0.58	8.33^{a}±1.15	9.33^{a}±0.58	44.33^{a}±3.51
NO_4	6.83^{c}±0.28	6.00^{b}±0.29	6.5^{b}±0.87	6.00^{b}±1.00	6.66^{c}±0.58	31.83^{b}±2.02

Values are mean ±SD of three replicates. Different letters in each column show significant difference at P≤ 0.05.
Treatments
NO_1: Control (with any addition).
NO_2: guava jam enhanced with 0.5% of natural red carrot pomace.
NO_3: guava jam enhanced with 1.0 % of natural red carrot pomace.
NO_4: guava jam enhanced with 1.5% of natural red carrot pomace.

Effect of storage on color intensity of guava jam measured as absorbance as 520 nm.

The color is a critical factor influencing the quality of the product. From Table (8), it could be noticed that color intensity of guava jam fortified with 1% (w/v) of natural colorant extracted from red carrot pomace decreased during three months either at ambient temperature or at 4°C from 0.960 to 0.466 and 1.395 to 0.810, respectively. The rate of decrement in color intensity was higher in samples stored at ambient temperature compared to the same at 4°C. These results are in agreement with those reported by Buckenhuskes (1993) and El- Massry *et al*. (2013).

Table 8. Effect of storage on color intensity of guava jam measured as absorbance as 520 nm.

Storage period (Weeks)	Color intensity	
	Ambient temperature (25±1°C)	At (4±1°C)
Zero time	0.960	1.395
1	0.890	1.333
2	0.830	1.301
3	0.790	1.266
4	0.750	1.212
5	0.700	1.195
6	0.670	1.166
7	0.644	1.112
8	0.612	0.970
9	0.588	0.903
10	0.533	0.888
11	0.490	0.843
12	0.466	0.810

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إستخدام المنتجات الثانوية لجذور الجزر الأحمر كمصدر للصبغات الطبيعية

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الملخص

يزداد الطلب هذه الأيام على الملونات الصديقة للبيئة/ غير السامة، خاصة للتطبيقات الصحية الحساسة مثل تلوين الأغذية. وفي الآونة الأخيرة، ظهرت الألوان المشتقة من المصادر الطبيعية لهذه التطبيقات كبديل مهم للألوان الصناعية الضارة. ويعتباراللون الطبيعي هو أحد العوامل الأساسية لقبول المستهلك لأي أغذية مصنعه. وتوجد العديد من المصادر للحصول على صبغة الأنثوسيانين من ثفل الجزر الأحمر. من المهم إستخلاص وإستخدام هذه الألوان الطبيعية كبديل طبيعي للون الأحمر في المربى. تم دراسة التركيب الكيميائي لمسحوق ثفل الجزر الأحمر. تم تقديرالرطوبة ، والبروتين الخام ومحتوى الرماد فى ثفل الجزر الأحمر المجفف وكانت ١٠,١٤ و ٤,٨٦ و ٥,٨٩٪ ، على التوالي. في الوقت نفسه ، كان يحتوي على قيمة أعلى من الكربوهيدرات والألياف الخام.

أما بالنسبة لمحتوى المعادن فقد لوحظ أن محتوى البوتاسيوم والصوديوم فى ثفل الجزر الأحمر قد وجد بكميات أكبر. ومن ناحية أخرى، كان المحتوى من المركبات الفينولية الكلية والفلافونويدات الكلية ١٠,٠٨ و ٥,١٥ ملجم/ جم على التوالى. كذلك، وكان نشاط مضادات الأكسدة ٨٦,٤٨٪. أشارت نتائج الفصل بجهاز HPLC إلى أن هناك مكونين رئيسيين للأنثوسيانين وهما cyanidin 3-glucoside الذي كان يمثل ٢٧٠,٦٢ ميكروجرام/ مل ، والآخر هو delphinidin بمقدار ٤٦,٣٩ ميكروجرام/مل. تمت دراسة تأثير الأس الهيدروجيني ودرجة الحرارة على ثبات الأنثوسيانين وأظهرت النتائج أن استقرار صبغة الأنثوسيانين كانت أكثر وضوحا عند قيم الأس الهيدروجيني الحمضية (١,٠ إلى ٥,٠) ، في حين أن أعلى انخفاض حدث عند الرقم الهيدروجيني ٧. وعلاوة على ذلك ، كان الأنثوسيانين المستخرج أكثر استقرارًا عند درجات الحرارة ٤٠ و ٦٠ درجة مئوية لمدة ٣٠ إلى ١٢٠ دقيقة. بينما على درجات حرارة ٨٠ و ١٠٠ درجة مئوية لمدة ٣٠ إلى ١٢٠ دقيقة تسبب ذلك فى حدوث إنخفاض في المحتوى من الأنثوسيانين. اما بالنسبة لإضافة مستخلص الأنثوسيانين بنسبة ١٪ أثناء تصنيع مربى الجوافة فكانت أكثر قبولا وسجلت أعلى معايير الجودة الحسية مقارنة بالتركيزات الأخرى متبوعة بالمعاملة التى اضيف اليها مستخلص الأنثوسيانين بنسبة ٠,٥٪. وقد لوحظ أن تأثير التخزين على كثافة اللون لمربى الجوافة ومعدل إنخفاض كثافة اللون كان أعلى في العينات المخزنة على درجة حرارة الغرفة مقارنة بالتخزين على درجة الحرارة عند ٤± ١°م درجه مئوية. وأخيرا ، يمكن إستنتاج أن ثفل الجزر الأحمر يعتبر مصدرا جيدا للأنثوسيانين الذي سجل ١٣٠,٥٤ مجم/ ١٠٠ جم على أساس الوزن الجاف.