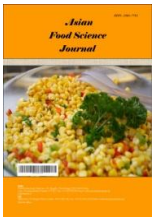

Asian Food Science Journal

20(4): 64-80, 2021; Article no.AFSJ.66376
ISSN: 2581-7752

Quality Characteristics of Carrot *(Daucus carota* L.*)* Puree Supplemented with Quinoa *(Chenopodium quinoa* Willd.*)*

M. M. Gomaa[1*], M. A. Gomaa[1] and W. M. M. Abd El-All[1]

[1]Food Technology Institute, Research Center of Agriculture, Giza, Egypt.

Authors' contributions

This work was carried out in collaboration among all authors. Authors MMG and WMMAEl-All were designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MMG, MAG and WMMAEl-All were managed the analyses of the study. Authors MMG and WMMAEl-All were managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AFSJ/2021/v20i430288
Editor(s):
(1) Dr. Cesar Ozuna Lopez, University of Guanajuato, Mexico.
Reviewers:
(1) Basma Mohamed Hendam, Mansoura University, Egypt.
(2) Amany Abd El-Salam Behairy Shoaib, Zagazig University, Egypt.
Complete Peer review History: http://www.sdiarticle4.com/review-history/66376

Original Research Article

Received 10 January 2021
Accepted 15 March 2021
Published 24 March 2021

ABSTRACT

The present study was performed to get a product loaded of nutrients in terms of protein, amino acids, vitamins, and antioxidants. The product had been made from mixtures of carrot and quinoa puree with mixing ratios 10%, 20% and 30% to reach the highest nutritional value and the best general palatability for the consumer. Carrot puree blends were analyzed for nutritional, chemical, microbial and sensory properties. It was found that by increasing the mixing ratio of quinoa with proportion of carrot the protein ratio reached 5.959 gm/100gm in blend (4) compared with 1.845gm/100 gm in blend (1). The best and highest results were in terms of protein and amino acids, especially essential ones, carrot quinoa puree in comparison with control indicated increase in minerals such as calcium 47.666 mg/100gm and iron 6.107 mg/100gm in blend (4) compared with the control were 35.171 mg/100gm and 3.242 mg/100gm, respectively. It was concluded that the greater the percentage of quinoa in substitution the higher the nutritional value and the better general acceptance. As for general palatability, the mixtures contained 10% followed by 20% had a

**Corresponding author: Email: gamalelhadidy1982@gmail.com;*

slight difference until the end of the experiment.
Therefore, it is recommended to utilize the quinoa seeds because of their high nutritional values in nutrition, where for children, the elderly and vegetarian people in several forms as flour in the baked goods or in a puree form added to fruits and vegetables.

Keywords: Quinoa; carrot; puree.

1. INTRODUCTION

It is well established that, cereals play an important role in human nutrition; quinoa (*Chenopodium quinoa* Willd.) is a plant belonging to the family *Amaranthaceae*. Quinoa is still little used because of the high cost of the imported grain and little knowledge of its benefits by most consumers. Several studies are needed to increase the knowledge about this "pseudo-cereal" and prove its functional and nutritional benefits. [1]. Quinoa has been studied latterly because it presents itself as an excellent source of energy, in addition to fibers, lipids, vitamins, minerals and protein of high nutritional value. I is mainly rich in lysine and valine which are higher or almost equivalent to the FAO / WHO requirement pattern in adults [2]. The protein content is more completed in quinoa than other most vegetables, where the amino acid constitution is close to the ideal protein balance recommended by the Food and Agriculture Organization (FAO) and similar to milk [3]. Moreover, the amino acid analysis displayed that quinoa is a fundamental source for lysine, methionine, cysteine besides other essential amino acids, and it meets or exceeds the recommendations for proper amino acid nutrition, in close agreement with previous observations by [4]. Although quinoa seeds contain bitter tasting saponins, these can be removed either by washing the seeds in cold water or by mechanical de-hulling [5], because the saponin is almost concentrated in the exterior seed layer, adhered to the pericarp covering two seed coat layers [6].

Carrot (*Daucus Carota* L.) is the most important crop of *Apiaceae* family. It is a root vegetable rich in carotenoids, flavonoids, poly-acetylenes, vitamins, and minerals, all of which posses numerous nutritional and healthy benefits. Besides healthy lending truth to the old adage that's why carrots are good for eyes, carotenoids, polyphenols and vitamins' existence in carrot act as antioxidants, anti-carcinogens, and immune-enhancers. Anti-diabetic, cholesterol lowering cardiovascular disease preventing, anti-hypertensive, hepatoprotective, renoprotective, and wound healing benefits were previously. Carrots were first used for medical purposes and step by step they were used as food [7].

Mashed foods are soft, moist, and smooth. They have the appearance and texture of a pudding or mousse and they hold together. Pureed foods should not be lumpy, thin, or runny. A pureed diet is needed for people who face troubles of chewing or swallowing.

Thus, the essence of this study was the assessment of quality characteristics of carrot puree supplemented or fortified with quinoa.

2. MATERIALS AND METHODS

2.1 Sources of Materials

1. Quinoa seeds (*Chenopodium quinoa* W*illd.)* were obtained from the Agriculture Research Center. Dokki., Egypt.
2. Carrot roots (*Daucus Carota* L.) were purchased from a local supermarket of Tanta, Egypt.

2.1.1 Preparation of quinoa de-saponins seeds

Rinse with **co**ld tap water while running your fingers through the quinoa seeds to eliminate a bitter taste is washed away.

2.1.2 Preparation of quinoa puree

Measure 250 gm of the quinoa seeds and add 600 ml of cold water to the quinoa in the pot. cook until the water comes to a rapid boil to 100 $^{\circ}$C for 15-20 min. and then turn the burner heat down to low.

2.1.3 Preparation of carrot

Carrot were weighted with ratio referred to in Table 1. washed , cut into 10 mm × 10 mm × 10 mm cubes and then soaked in 0.1% (w/w) boiling sodium bicarbonate solution for 2 min. to prevent browning reaction and then washed in cold water [8].

2.1.4 preparation of carrot puree

The carrot cubes with quinoa de-saponins seeds were boiled in boiling water (100ºC) for 5 min and then cooled. Finally, the A 88Tissue Pulverizer (Laiheng Lab-Eqipments, Bijing, China) [8].

2.1.5 Preparation of carrot and quinoa puree production

Adding quinoa puree to carrot puree as shown in Table 1.

2.2 Chemical Analysis

Moisture content, crude protein and ash content were determined according to the standards of [9], while, crude fat and crude fiber were approximated by using the methods described in the [10]. On the other hands total carbohydrates estimated by subtracting the difference from initial weight of the samples as follows:

Carbohydrates (%) = 100 – (% Crude Protein + % Crude Fat + % Ash + % Crude Fibers) on dry weight. Total carbohydrates contents were calculated according to *James (1995)* while, energy value was estimated as follows:

Energy value = (% Carbohydrates × 4.1) + (% Protein × 4.1) + (% Fat × 9.1). energy value contents were calculated according to [11].

2.2.1 Determination of amino acids

Amino acids were determined according to the method described by Pellet and Young [12]. A known weight of the dried free fat samples was hydrolyzed and filtered, the residue was rinsed with distilled water, then 5 ml of the filtrate was evaporated on water bath at 50 °C. The residue was dissolved in 5 ml loading buffer (0.2 sodium citrate buffer of pH 2.2). Amino acids were determined chromatographically using Beckman Amino Acid Analyzer Model 119 CL., at Central Lab., Regional Center for Food and Feed (RCFF), Giza, Egypt [9]. Total free amino acids were determined at the same lab.

2.2.2 Determination of minerals content

The determination took place in Central Laboratory, Faculty of Agriculture, Kafr El-Sheikh University, as described in [13].

2.2.3 Determination of total phenolic compounds

Total phenolic compounds content was determined using Folin-Ciocalteu reagent according to the method described by [14]. Gallic acid was used for calibration curve. Results were expressed as mg gallic acid (GAE)/g.

2.2.4 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 [15]. The percentage inhibition of DPPH radical by the samples was enumerated as mentioned in the formula of [16].

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.

2.2.5 Determination of ascorbic acid

Ascorbic acid (V.C) was determined using 2,6-dichlorophenolindophenol titrimetric method as described in [9]. The results were expressed in milligrams ascorbic acid per 100 ml of fruit juice.

2.2.6 Determination of pH values

The pH values of puree were measured using bench top pH-meter [9].

2.2.7 Determination of total soluble solid (T.S.S.)

This was determined in the juice by the refractometric method at room temperature using a polish manual at room temperature using a polish manual refractometr (R R 12, Nr 05116, 0-35% at 20°C) according to the method given in the [9].

2.2.8 Determination of total titratable acidity (T.T.A.)

This was determined in the extracted juices as described in [9].

2.2.9 Determination of carotenoids content

Total carotenoids of samples were determined according to the methods according to [17] and

[18]. Five grams of each sample were mixed with 30 ml of 85% acetone in dark bottle and left at room temperature for 15 hrs. then filtered on glass wool into a 100 ml volumetric flask and made up to volume by 85% acetone solution. Absorbance for the prepared extracts was read on the spectrophotometer at wavelength of 662, 644 and 440 nm. A blank experiment using acetone (85%) was carried out. The contents of total carotenoids and chlorophylls were calculated using the following equations:

Chlorophyll A (mg/L) = (9.784 × E662) – (0.99 × E664).
Chlorophyll B (mg/L) = (21.426 × E644) – (4.65 × E662).
Total carotenoids (mg/L) = 4.695 × E 440 – 0,268 × (chl. A + chl. B).

2.3 Sensory Evaluation

Sensory evaluation (color, taste, odor, texture and over all acceptability) of puree carrot and quinoa were conducted by more than ten panelists (chosen by random) in the Food Technology Research Institute, according to the method of [19].

2.4 Determination of Microbial Counts or Microbial Enumeration

The microbial contents were determined according to methods described in the DIFCO manual [20]. Acidified potato dextrose agar and nutrient agar were used to count yeast & mild and total microbial counts, respectively. Three plates of these cultures were enumerated and expressed as colony forming units per gram sample (CFU/g).

2.5 Statistical Analysis

This was evaluated through analysis of variance (ANOVA) using statistical software SPSS for Windows, version 19.0 (SPSS Inc., Chicago, IL, 245 USA). Duncan's multiple range test ($P \leq 0.05$) was used to detect differences among means. This was carried out according to [21].

3. RESULTS AND DISCUSION

Quinoa and quinoa products are rich not only in macronutrients, such as protein, poly saccharides and fat, but also were rich in micronutrients such as poly-phenols, vitamins and minerals [22].

Their high protein content ranged from 13.1 to 16.7%. This data is agreement with [23].

From Table (2), it could be noticed that increasing the ratio of quinoa puree led to an enhancement in the nutritional value of the product, which is clear in raising the values of protein, fat, fiber and ash.

It could be noticed that in blend (1) protein, fat, fiber and ash were 1.845, 5.267, 4.567 and 9.934 in blend (1) and reached to 5.959, 6.326, 6.075 and 11.216 in blend (4), respectively at zero time. Also, there were a decreased in calories in blend (4) compared with blend (1) after four months storage.

On the flip-side, the current findings reported non-significant changes along the storage period for all blends where, the ratio of protein, fat, fiber and ash in blend (2), blend (3) and blend (4) were (2.983, 5.237, 5.021 and 10.091 gm), (4.305, 6.122, 5.217 and 10.333 gm) and (5.959, 6.326, 6.075 and 11.216 gm), respectively on dry weight basis.

Quinoa protein is referred as a high quality protein with higher content of lysine, methionine and therionine compared to wheat and maize [24].

National Academy of Sciences [25] showed that quinoa has an excellent amino acids balance with higher lysine (5.1 % to 6.4 %) and methionine (0.4 % to 1.0 %) content. These results were also reported by [26] and [27].

Table 3. and Fig. 2. indicate significant increases in all amino acids by increasing the ratios of quinoa purees particularly lysine, methionine and valine as essential amino acids. They were (0.050, 0,020 and 0.060 g/100g) in blend (1) while reached (0.329, 0.124 and 0.329 g / 100g), respectively in blend (4) also the non-essential amino acids (arginine and alanine) were (0.110 and 0.100 g / 100 g) in blend (1) increased to (0.536 and 0.412 g / 100g) in blend (4).

Table 1. Percentage of ingredients used to develop the puree products

Blends	Carrot roots (%)	Quinoa seeds (%)
Blend (1) 0 % quinoa	100	---
Blend (2) 10 % quinoa	90	10
Blend (3) 20 % quinoa	80	20
Blend (4) 30 % quinoa	70	30

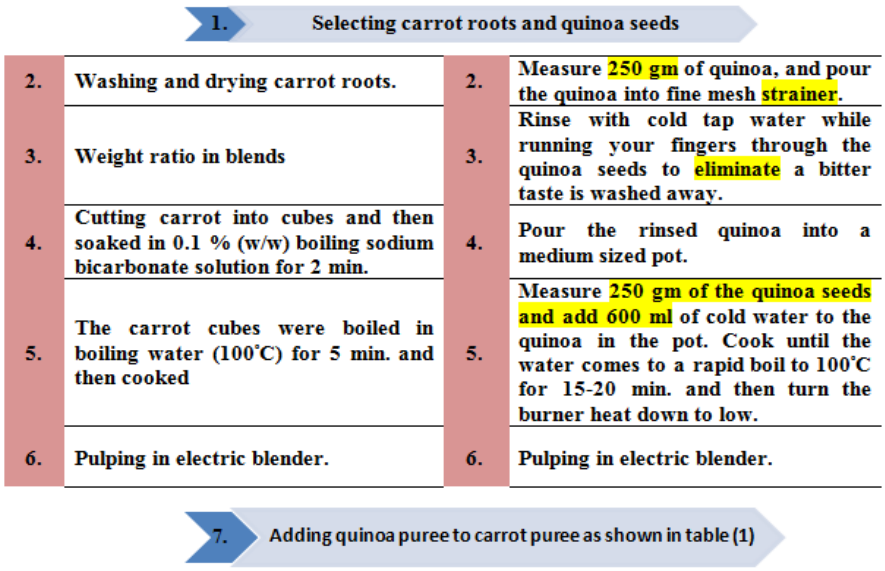

Fig. 1. Preparation of blending carrot – quinoa puree

Results from Table 3. and Fig. 2. were pointed to a raise in essential amino acids and non-essential amino acids ratios in blend (4) were 2.224 and 4.307 g /100 g samples compared with blend (1) were 0.330 and 1.204 g /100 g samples, respectively.

These all led to a noticed flow in total amino acids 1.534 g / 100g samples in blend (1) to 6.531 g / 100g samples in blend (4).

These results are in agreement with [28]. Quinoa is an Andean Pseudo cereal that has 14.6% protein. This protein is notably high quality and is particularly rich in histidine and lysine (3.2 and 6.1 %) of protein composition, respectively. Similarly with those results were reported by [29] who stated that quinoa flour demonstrated a protein content of 14.2 g/100g and high grads of essential amino acids as lysine.

Demir and Kilinc [30] reached to use quinoa flour to increase ash, crude protein, crude fat and total phenolic content (T.P.C.) of cookie samples (P≤ 0.06). The potassium (K), magnesium (Mg), calcium (Ca), iron (Fe) and zinc (Zn) contents of the cookies were enhanced with increasing levels of quinoa flour.

Quinoa seeds are loaded with of calcium, magnesium, iron, copper and zinc. Furthermore, calcium, magnesium and potassium are found in quinoa in bioavailable composition, thus their contents are considered to be suitable for a balanced diet [22].

As demonstrated in Table 4. “K” in blend (1) has the highest value 1606.267 mg / 100 g thus because carrot is very rich in “K”, so it is gradually decreased for all blends.

“Ca” and “Fe” show a significant increase from blend (1) to blend (4) while “Zn” has a slight increase as the ratio of quinoa puree increased.

Data in Table 5. revealed a significant difference in all blends where, T.S.S. decreased in blend (4) was 10.5 compared with blend (1) was 13.

All blends decreased in total solid soluble solids (T.S.S.) for example, blend (1), blend (2), blend (3) and blend (4) decreased from 13, 11.5, 11

and 10.5 to 11, 9.5, 9 and 8.5, for long the storage period, respectively.

It can be seen from data in Table 6. and Fig. 3. that there were degradations in carotenoids for all blends for the long storage period. Instead, there were differences between blend (1) to blend (4) due to the increase of quinoa puree ratios. Where, the highest value for carotenoids was in blend (1) 8.194 mg / 100 g and decreased to 4.840 mg / 100 g at the end of the storage period. All blends were decreased during the storage times but blend (1) was the highest while, the lowest one was blend (4).

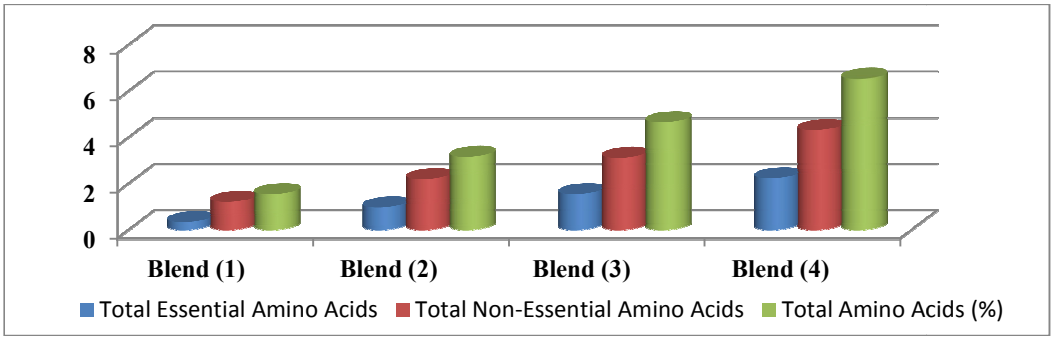

Fig. 2. Essential amino acids, non-essential amino acids and total amino acids of blends puree

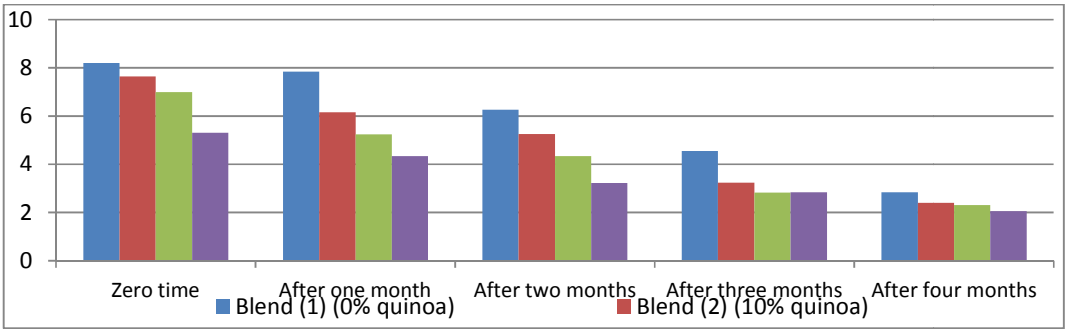

Fig. 3 Carotenoids for treatments puree during four months storage (mg/100 gm samples) on dry weight basis

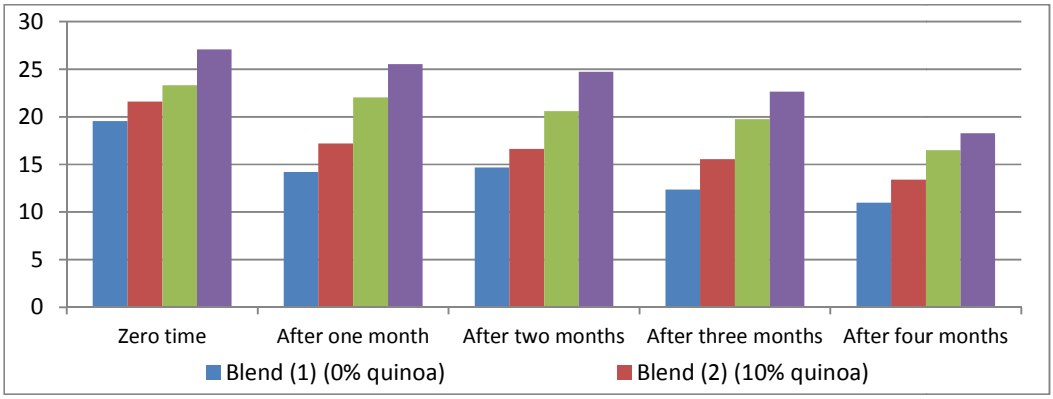

Fig 5. Antioxidant activity for treatments puree during storage times (%) on dry weight basis

Table 2. Chemical composition for blends puree blends during storage times

Treatments Puree			Chemical composition for blends (gm/100gm sample)						
			Moisture contents	Ash*	Protein*	Fat*	Fiber*	Available Carbohydrates***	Total energy value
Blend (1) (0% quinoa)	Storage times	Zero time	88.898 ±0.279[a]	9.934 ±0.048[c]	1.845 ±0.066[d]	5.267 ±0.109[d]	4.567 ±0.097[c]	78.387 ±0.316[a]	368.331 ±0.192[a]
Blend (2) (10% quinoa)			87.820 ±0.394[b]	10.842 ±0.075[b]	3.327 ±0.186[c]	5.849 ±0.079[c]	5.560 ±0.219[b]	74.420 ±0.237[b]	363.634 ±0.823[b]
Blend (3) (20% quinoa)			86.250 ±0.144[c]	10.391 ±0.309[bc]	4.711 ±0.109[b]	6.487 ±0.175[b]	5.747 ±0.062[b]	72.929 ±0.307[c]	368.944 ±0.901[a]
Blend (4) (30% quinoa)			86.071 ±0.377[c]	11.667 ±0.256[a]	6.561 ±0.107[a]	7.061 ±0.040[a]	6.543 ±0.115[a]	68.166 ±0.506[d]	362.467 ±1.285[b]
Blend (1) (0% quinoa)		After one month	88.598 ±0.488a	9.847 ±0.061c	1.802 ±0.014d	5.338 ±0.235c	4.624 ±0.095c	78.388 ±0.395b	368.808 ±0.614a
Blend (2) (10% quinoa)			87.381 ±0.458a	10.444 ±0.089b	3.254 ±0.120c	5.987 ±0.180b	5.341 ±0.140b	78.407 ±3.794b	380.381 ±13.947a
Blend (3) (20% quinoa)			86..064 ±0.397b	10.693 ±0.145b	4.722 ±0.117b	6.202 ±0.088b	5.585 ±0.131b	72.796 ±0.242ab	365.897 ±0.283a
Blend (4) (30% quinoa)			85.846 ±0.120b	11.399 ±0.138a	6.561 ±0.150a	6.967 ±0.045a	6.618 ±0.141a	68.453 ±0.456b	362.763 ±0.874a
Blend (1) (0% quinoa)		After two months	88.301 ±0.491a	9.868 ±0.026c	1.769 ±0.097d	5.239 ±0.129d	4.465 ±0.148d	78.657 ±0.397d	346.230 ±1.237a
Blend (2) (10% quinoa)			87.790 ±0.077a	10.385 ±0.088b	3.271 ±0.158c	5.802 ±0.052c	5.105 ±0.082c	75.435 ± 0.380c	343.841 ±0.636ab
Blend (3) (20% quinoa)			86.498 ±0.091b	10.589 ±0.099b	4.755 ±0.136b	6.382 ±0.099b	5.521 ±0.119b	72.752 ±0.451b	341.940 ±0.777b
Blend (4) (30% quinoa)			86.245 ±0.123b	11.448 ±0.112a	6.359 ±0.104a	6.842 ±0.096a	6.377 ±0.114a	68.973 ±0.424a	335.542 ±0.806c
Blend (1) (0% quinoa)		After three months	88.535 ±0.036a	9.509 ±0.047d	1.535 ±0.005d	5.135 ±0.006d	4.214 ±0.004d	79.605 ±0.062a	370.783 ±0.180a
Blend (2) (10% quinoa)			87.630 ±0.042b	10.252 ±0.011c	3.155 ±0.096c	5.714 ±0.058c	5.055 ±0.039c	75.822 ±0.203b	367.341 ±0.129b
Blend (3) (20% quinoa)			86.333 ±0.029c	10.531 ±0.026b	4.631 ±0.064b	6.405 ±0.133b	5.416 ±0.062b	73.149 ±0.151c	367.573 ±0.262b
Blend (4) (30% quinoa)			86.229 ±0.012d	11.325 ±0.020a	6.131 ±0.060a	6.749 ±0.038a	6.272 ±0.011a	69.521 ±0.121d	363.353 ±0.101c

Treatments Puree		Chemical composition for blends (gm/100gm sample)						
		Moisture contents	Ash*	Protein*	Fat*	Fiber*	Available Carbohydrates***	Total energy value
Blend (1) (0% quinoa)	After four months	88.208 ±0.057a	9.014 ±0.007d	1.313 ±0.022d	4.979 ±0.009d	4.025 ±0.012d	80.668 ±0.049a	375.641 ±3.067a
Blend (2) (10% quinoa)		87.447 ±0.039b	10.091 ±0.036c	2.983 ±0.007c	5.237 ±0.019c	5.021 ±0.012c	76.666 ±0.072b	365.870 ±0.107bc
Blend (3) (20% quinoa)		86.223 ±0.246c	10.333 ±0.019b	4.305 ±0.052b	6.122 ±0.065b	5.217 ±0.008b	74.022 ±0.144c	368.409 ±0.220b
Blend (4) (30% quinoa)		86..094 ±0.046c	11.216 ±0.028a	5.959 ±0.029a	6..326 ±0.046a	6.075 ±0.034a	70.423 ±0.133d	362.464 ±0.036c

( ) On dry weight basis. (**) Available carbohydrates by difference

All values are means of three replicates ± SD. Value in the same column with different letters (a, b, c, d, e...etc. are significantly different (p≤ 0.05)

Table 3. Amino acids contents of treated purees (gm/100 gm dry samples)

Amino Acids	Treatments	Amino acids for blends			
		Blend (1) (0% quinoa)	Blend (2) (10% quinoa)	Blend (3) (20% quinoa)	Blend (4) (30% quinoa)
Essential Amino Acids	*Isoleucine(ILE)	0.070	0.273	0.377	0.536
	*Leucine(LEU)	0.060	0.210	0.314	0.453
	*Lysine(LYS)	0.050	0.126	0.219	0.329
	*Methionine	0.020	0.063	0.094	0.124
	*Phenylalanine(PHE)	0.020	0.042	0.157	0.206
	*Therionine(THR)	0.050	0.105	0.157	0.247
	*Valine(VAL)	0.060	0.147	0.219	0.329
Total Essential Amino Acids		0.330	0.966	1.537	2.224
Total Non-Essential Amino Acids	***Alanine(ALA)	0.100	0.189	0.283	0.412
	***Argnine(ARG)	0.110	0.210	0.345	0.536
	***Aspartic (ASP)	0.180	0.336	0.471	0.577
	***Cystine(CYS)	0.004	0.021	0.063	0.062
	***Glutamic(GLU)	0.610	0.883	1.099	1.443
	***Glycine(GLY)	0.060	0.189	0.283	0.412
	***hisitidine(HIS)	0.020	0.063	0.094	0.165
	***Proline(PRO)	0.050	0.105	0.126	0.206
	***Serine(SER)	0.040	0.105	0.126	0.288
	***Tyrosine(TYR)	0.030	0.084	0.219	0.206
Total Non-Essential Amino Acids		1.204	2.185	3.109	4.307
Total Amino Acids (%)		1.534	3.151	4.646	6.531

Table 4. Minerals for treatments puree on dry weight basis

Treatments \ Storage times	Minerals (mg / 100 gm sample)			
	K	Ca	Zn	Fe
Blend (1) (0% quinoa)	1606.267 ±1.831[a]	35.171 ±0.074[d]	1.091 ±0.005[d]	3.242 ±0.082[d]
Blend (2) (10% quinoa)	1223.360 ±0.865[b]	36.879 ±0.069[c]	1.525 ±0.009[c]	4.358 ±0.077[c]
Blend (3) (20% quinoa)	837.304 ±1.129[c]	41.765 ±0.139[b]	1.707 ±0.011[b]	4.888 ±0.082[b]
Blend (4) (30% quinoa)	732.115 ±2.023[d]	47.666 ±0.139[a]	1.809 ±0.008[a]	6.107 ±0.087[a]

All values are means of three replicates ± SD. Value in the same column with different letters (a, b, c, d, e...etc. are significantly different (p≤ 0.05)

Table 5. Total solid solubility for treatments puree during storage times

Treatments \ Storage times	Total solid soluble solids (T.S.S.)				
	Zero time	After 1 month	After 2 months	After 3 months	After 4 months
Blend (1) (0% quinoa)	13.00	12.50	12.00	11.50	11.00
Blend (2) (10% quinoa)	11.50	11.00	10.50	10.00	9.50
Blend (3) (20% quinoa)	11.00	10.50	10.00	9.50	9.00
Blend (4) (30% quinoa)	10.50	10.00	9.50	9.00	8.50

Table 6. Carotenoids for treatments puree during storage times on dry weight basis

Storage times / Treatments	Carotenoids (mg/100gm samples)				
	Zero time	After 1 month	After 2 months	After 3 months	After 4 months
Blend (1) (0% quinoa)	8.194 ±0.014[a]	7.831 ±0.052[a]	6.268 ±0.043[a]	5.551 ±0.040[a]	4.840 ±0.044[a]
Blend (2) (10% quinoa)	7.648 ±0.101[b]	6.167 ±0.052[b]	5.251 ±0.080[b]	3.235 ±0.125[b]	2.408 ±0.056[b]
Blend (3) (20% quinoa)	6.984 ±0.009[c]	5.244 ±0.053[c]	4.340 ±0.040[c]	2.830 ±0.041[c]	2.316 ±0.117[c]
Blend (4) (30% quinoa)	5.313 ±0.008[d]	4.335 ±0.035[d]	3.230 ±0.079[d]	2.839 ±0.084[c]	2.058 ±0.116[c]

All values are means of three replicates ± SD. Value in the same column with different letters (a, b, c, d, e...etc. are significantly different (p≤ 0.05)

The utilization of heat may increase the availability of carotenoids, even there were significant losses after and during the processing [31]. During storage a decreased in beta-carotene was reported in papay a jam [32]. However, [33] showed a higher loss in carotenoids during processing and storage. The decrease in carotene content of pumpkin candy may be attributed to high susceptibility of carotenoids to auto-oxidative deterioration during processing and storage of foods as suggested by [34].

Carotenoids are affected by some reactions such as oxidation and isomerization (cis-trans) throughout food processing and storage especially due to light, heat, acids and oxygen, thus give rise to loss of color and reduction of biological activity [35] and [31].

The results from Table 7. explain the event augment of weight phenolic compounds in blend (4) which was 45.666 mg / 100 g compared to blend (1) which was 27.66 mg / 100 g. It is due to the increase in quinoa puree ratios which is loaded with phenolic compounds. While, there was degradation in phenolic compounds for all blends during the storage period, but the highest one was for blend (4) was 31.667 mg / 100 g and the lowest one from blend (1) was 17.666 mg / 100 g.

Table 8. shows that adding quinoa puree enriches the anti-oxidant activity in the products. As we can notice the anti-oxidant activity in blend (1) was 19.566 % while, in blend (4) was 27.073 % at zero time. But at the end of the conservation period in blend (1) reached 10.980 % while, in blend (4) was 18.286 %.

The results show the influence of different treatments (blends) and storage period on “pH” presented in Table 9. The “pH” value for food is a directly related to the free hydrogen ions in that food. The “pH’’ of all puree samples was decreased during storage as shown in Table 9. while increased gradually as the ratio of quinoa puree increased.

The lowest “pH” score was observed 6.073 for blend (1) and highest score was observed 7.124 for blend (4) at zero time. Changes in “pH” are directly related to which happen the acidity of samples, during storage intervals “pH” decreased as the increase in acidity during storage. This may be due to the formation of acidic compounds. Similar results were previously reported by [36].

All blends in Table 10. demonstrated a gradual loss in vitamin “C”. It should be noted that it is sensitive to processing and unstable during storage period. Thus, this vitamin is often used as an indicator of the quality of fruits and vegetables in the distribution chain [37].

The ascorbic acid variations in the four blends may be due to the substations of quinoa puree instead of carrot puree, thus the highest score was for blend (1) 15.733 mg / 100g and the lowest one was for blend (4) 8.396 at zero time often four months, blend (1) reached 8.268 mg / 100 g while blend (4) was 3.275 (mg / 100 g sample) and this may be attributed to the reduction of ascorbic acid during the storage period due to the oxidation of ascorbic acid to de-hydro ascorbic acid.

Sabeera et al. [38] indicated that the ascorbic acid (9.15 mg/100g) of fresh candy is decreased significantly with storage at ambient temperature. [39] revealed that the ascorbic acid values tend to decrease by 50% with the duration of storage of pear candies.

Table 7. Phenol compounds for treatments puree during storage times (mg/100gm samples) on dry weight basis

Storage times / Treatments	Phenol compounds (mg/100gm samples)				
	Zero time	After 1 month	After 2 months	After 3 months	After 4 months
Blend (1) (0% quinoa)	27.666 ±0.333[d]	26.333 ±0.666[d]	22.666 ±0.333[d]	20.666 ±0.333[d]	17.666 ±0.333[d]
Blend (2) (10% quinoa)	38..666 ±0.333[c]	35.000 ±0.001[c]	31.666 ±0.333[c]	29.666 ±0.333[c]	26.666 ±0.333[c]
Blend (3) (20% quinoa)	42.000 ±0.001[b]	36.333 ±0.333[b]	34.666 ±0.334[b]	32.667 ±0.333[b]	29.667 ±0.333[b]
Blend (4) (30% quinoa)	45.666 ±0.333[a]	39.666 ±0.333[a]	36.666 ±0.333[a]	34.676 ±0.333[a]	31.667 ±0.333[a]

All values are means of three replicates ± SD. Value in the same column with different letters (a, b, c, d, e...etc. are significantly different (p≤ 0.05)

Table 8. Antioxidant activity for treatments puree during storage times (%) on dry weight basis

Storage times / Treatments	Antioxidant activity (%)				
	Zero time	After 1 month	After 2 months	After 3 months	After 4 months
Blend (1) (0% quinoa)	19.566 ±0.501[d]	14.863 ±0.424[d]	14.686 ±0.552[d]	12.376 ±0.460[d]	10.980 ±0.330[d]
Blend (2) (10% quinoa)	21.616 ±0.433[c]	17.210 ±0.193[c]	16.600 ±0.698[c]	15.560 ±0.724[c]	13.416 ±0.575[c]
Blend (3) (20% quinoa)	23.336 ±0.228[b]	22.040 ±0.157[b]	20.616 ±0.579[b]	19.753 ±0.583[b]	16.483 ±0.454[b]
Blend (4) (30% quinoa)	27.073 ±0.389[a]	25.546 ±0.514[a]	24.730 ±0.447[a]	22.666 ±0.538[a]	18.286 ±0.597[a]

All values are means of three replicates ± SD. Value in the same column with different letters (a, b, c, d, e...etc. are significantly different (p≤ 0.05)

Table 9. pH for treatments puree during storage times

Storage times / Treatments	pH				
	Zero time	After 1 month	After 2 months	After 3 months	After 4 months
Blend (1) (0% quinoa)	6.073 ±0.042[d]	5.733 ±0.106[b]	5.525 ±0.028[b]	4.737 ±0.142[b]	4.624 ±0.151[c]
Blend (2) (10% quinoa)	6.514 ±0.020[c]	5.911 ±0.021[b]	5.669 ±0.061[b]	5.748 ±0.129[a]	5.467 ±0.203[b]
Blend (3) (20% quinoa)	6.657 ±0.034[b]	5.944 ±0.035[b]	5.774 ±0.138[b]	5.651 ±0.172[a]	5.597 ±0.164[ab]
Blend (4) (30% quinoa)	7.124 ±0.064[a]	6.303 ±0.052[a]	6.301 ±0.189[a]	6.120 ±0.155[a]	6.104 ±0.145[a]

All values are means of three replicates ± SD. Value in the same column with different letters (a, b, c, d, e...etc. are significantly different (p≤ 0.05)

Table 10. Vitamin "C" (ascorbic acid) for different treatments puree during four months storage

Storage times / Treatments	Vitamin "C" (Ascorbic Acid) (mg/100gm sample)				
	Zero time	After 1 month	After 2 months	After 3 months	After 4 months
Blend (1) (0% quinoa)	15.733 ±0.063[a]	13.391 ±0.185[a]	11.395 ±0.197[a]	10.285 ±0.089[a]	8.268 ±0.109[a]
Blend (2) (10% quinoa)	10.656 ±0.066[b]	9.090 ±0.116[b]	8.026 ±0.243[b]	7.346 ±0.102[b]	5.972 ±0.127[b]
Blend (3) (20% quinoa)	9.623 ±0.092[c]	7.948 ±0.114[c]	6.439 ±0.197[c]	6.001 ±0.129[c]	4.442 ±0.126[c]
Blend (4) (30% quinoa)	8.396 ±0.082[d]	6.996 ±0.180[d]	5.376 ±0.183[d]	4.730 ±0.115[d]	3.275 ±0.119[d]

All values are means of three replicates ± SD. Value in the same column with different letters (a, b, c, d, e...etc. are significantly different (p≤ 0.05)

Sandhu [40] also observed that there was a decreasing trend in ascorbic acid contents of papaya candy during storage at both ambient and refrigerated temperatures. The reduction in ascorbic acid content may be possible due to the oxidation of ascorbic acid as reported by [39] in pear candy.

Microbial growth is an important criterion that must be fulfilled. The determination of storage periods depends on the type of food product.

The effect of storage for carrot quinoa puree was studied along the storage period, hence the microbial growth was studied to determine the shelf life of the blends. So, it wasn't observed yeast or mold growth in the beginning of the experiment and also after the first and the second month. The third month, it was noticed very little spots, and increased at the fourth month resulting in stopping the storage period.

The yeast and mold count was 2.301 log CFU/g and didn't appear after 4 months of storage, on the other hand, it reached 4.274, 4.017 and 2.602 log CFU/g in blend 1, 2 and 3, respectively and it wasn't observed in blend 4 for the total count. All blends didn't show microbial spots at the begging of the experiment, and starting to appear after the first month, which reached 3.301, 3.001, 2.903 and 2.778 log CFU/g in blend 1, 2, 3 and 4, respectively. These percentages get increased till reached the fourth month in blend 1, 2 and 3 which were 4.544, 4.414 and 4.342 log CFU/g, respectively and 3.799 log CFU/ g in blend 4.

Table 11. Microbiological quality of experimental carrot-quinoa puree prepared from different ratios of quinoa for total bacterial count (TC) and yeasts and molds count (Y&M) as log CFU/g

Storage times / Treatments	Storage periods (month)									
	Zero time		After 1 month		After 2 months		After 3 months		After 4 months	
	TC	Y&M	TC	Y&M	TC	Y&M	TC	Y&M	TC	Y&M
Blend (1) (0% quinoa)	--	ND	3.301	ND	3.681	ND	3.838	2.301	4.544	4.274
Blend (2) (10% quinoa)	--	ND	3.001	ND	3.556	ND	3.633	ND	4.414	4.017
Blend (3) (20% quinoa)	--	ND	2.903	ND	3.447	ND	3.568	ND	4.342	2.602
Blend (4) (30% quinoa)	--	ND	2.778	ND	3.342	ND	3.361	ND	3.799	ND

Fig. 6. Sensory properties (Over all acceptability) and microbiological experimental (total count and molds and yeast) for control and other blends

It's clear that the best blend was blend 4 followed by blend 3 and blend 2 these results explained by the existence of quinoa puree in these blends and the feature of the antimicrobial effect in quinoa seeds.

Table (12). shows the color, texture, taste, odor, flavor and over all palatability for all blends. The results indicated that all properties were maintained good for blends (1, 2 and 3), while were accepted for blend (4). All sensory characteristics for blends were accepted during the storage period and gradually decreased but they were detected for blend (1) and (2) after four months.

Table 12. Sensory evaluation of treatments (carrot and quinoa puree during storage time)

Treatments Puree		Sensory evaluation for treatments					
		Color (10)	Texture (10)	Taste (10)	Odor (10)	Flavor (10)	Over all acceptability (10)
Blend (1) (0% quinoa)	Zero time	8.791 ±0.189^{b}	8.583 ±0.193^{b}	8.708 ±0.156^{b}	8.3785 ±0.151^{b}	8.375 ±0.185^{b}	8.333 ± 0.338^{a}
Blend (2) (10% quinoa)	Zero time	8.208 ±0.264^{ab}	7.916 ±0.306^{ab}	7.583 ±0.312^{a}	7.875 ±0.332^{ab}	7.916 ±0.252^{ab}	8.001 ±0.325^{a}
Blend (3) (20% quinoa)	Zero time	8.333 ±0.291^{ab}	7.875 ±0.381^{ab}	7.125 ±0.369^{a}	7.4587 ±0.366^{ab}	7.583 ±0.393^{ab}	7.791 ±0.376^{a}
Blend (4) (30% quinoa)	Zero time	7.666 ± 0.432^{a}	7.416 ±0.525^{a}	6.751 ±0.565^{a}	6.916 ±0.599^{a}	6.833 ±0.588^{a}	7.291 ±0.516^{a}
Blend (1) (0% quinoa)	After one month	8.833 ±0.112^{a}	8.333 ±0.142^{a}	7.916 ±0.148^{a}	7.833 ±0.112^{a}	7.583 ±0.148^{a}	7.751 ±0.131^{a}
Blend (2) (10% quinoa)	After one month	7.916 ±0.083^{ab}	7.833 ±0.112^{b}	7.583 ±0.148^{a}	7.583 ±0.148^{a}	7.333 ±0.142^{ab}	7.667 ±0.142^{a}
Blend (3) (20% quinoa)	After one month	7.583 ±0.148^{ab}	7.166 ±0.112^{c}	7.083 ±0.083^{b}	7.001 ±0.001^{b}	7.001 ±0.002^{b}	7.083 ±0.083^{b}
Blend (4) (30% quinoa)	After one month	6.833 ±0.166^{c}	6.666 ±0.142^{d}	6.751 ±0.131^{b}	6.333 ±0.142^{c}	6.501 ±0.151^{c}	6.416 ±0.148^{c}
Blend (1) (0% quinoa)	After two months	8.501 ±0.151^{a}	8.416 ±0.148^{a}	7.833 ±0.112^{a}	7.751 ±0.131^{a}	7.751 ±0.131^{a}	8.001 ±0.001^{a}
Blend (2) (10% quinoa)	After two months	8.001 ±0.001^{b}	8.001 ±0.001^{b}	7.251 ±0.131^{b}	6.916 ±0.083^{b}	6.916 ±0.083^{b}	7.333 ±0.142^{b}
Blend (3) (20% quinoa)	After two months	7.166 ±0.112^{c}	6.833 ±0.112^{c}	6.667 ±0.142^{c}	6.676 ±0.142^{b}	6.666 ±0.142^{b}	6.501 ±0.151^{c}
Blend (4) (30% quinoa)	After two months	6.916 ±0.083^{c}	6.333 ±0.142^{d}	6.251 ±0.131^{d}	6.001 ±0.001c	6.083 ±0.083^{c}	6.166 ±0.112^{c}
Blend (1)	: r e -	8.166	8.166	7.583	7.251	7.001	7.833

Storage times

Treatments Puree		Sensory evaluation for treatments					
		Color (10)	Texture (10)	Taste (10)	Odor (10)	Flavor (10)	Over all acceptability (10)
(0% quinoa)		±0.112[a]	±0.112[a]	±0.148[a]	±0.131[a]	±0.001[a]	±0.112[a]
Blend (2)		7.333	7.333	6.751	6.751	6.667	7.001
(10% quinoa)		±0.142[b]	±0.142[b]	±0.131[b]	±0.131[b]	±0.142[b]	±0.001[b]
Blend (3)		6.751	6.083	6.001	6.083	6.001	6.083
(20% quinoa)		±0.131[c]	±0.083[c]	±0.001[c]	±0.083[c]	±0.001[c]	±0.083[c]
Blend (4)		5.166	5.251	5.166	5.083	5.083	5.251
(30% quinoa)		±0.112[d]	±0.131[d]	±0.112[d]	±0,083[d]	±0.083[d]	±0.131[d]
Blend (1) (0% quinoa)	After four months	****	****	****	****	****	****
Blend (2) (10% quinoa)		****	****	****	****	****	****
Blend (3)		5.833	5.166	5.001	5.083	5.001	5.083
(20% quinoa)		±0.112[a]	±0.112[a]	±0.001[a]	±0.083[a]	±0.001[a]	±0.083[a]
Blend (4)		5.001	4.167	4.083	4.001	4.001	4.251
(30% quinoa)		±0.123[a]	±0.112[a]	±0.083[a]	±0.001[a]	±0.001[a]	±0.131[a]

All values are means of three replicates ± SD. Value in the same column with different letters (a, b, c, d, e...etc. are significantly different (p≤ 0.05)

4. CONCLUSION

Carrot and quinoa are rich source for nutraceuticals compounds such as vitamins, antioxidants. Vitamin C and beta carotene are present in abundance in carrot and import high antioxidant potential to it. These compounds can be returned by processing carrot into puree.

Purees production not only improves the shelf life of vegetables but also maintains its antioxidant potential.

Estimating the termination date is very complex due to difficulties in determining limits of product acceptability.

It could be observed that increasing the ratio of quinoa puree led to an increasing in all the nutrition`s values of the product, such as protein, fat, fiber and ash.

Quinoa and quinoa products are rich not only in macronutrients, such as protein, poly saccharides and fat, but also were rich in micronutrients such as poly-phenols, vitamins and minerals.

The values of protein, fat, fiber and ash were 1.845, 5.267, 4.567 and 9.934 in blend (1) and reached to 5.959, 6.326, 6.075 and 11.216 in blend (4), respectively during four months storage.
After four months results pointed out that, there were no significant changes mentioned along the storage period for all blends where, the ratio of protein, fat, fiber and ash in blend (2), blend (3) and blend (4) were (2.983, 5.237, 5.021 and 10.091 gm.), (4.305, 6.122, 5.217 and 10.333 gm.) and (5.959, 6.326, 6.075 and 11.216 gm.), respectively on dry weight basis.

All blends have increases in all amino acids while, increasing the ratios of quinoa purees particularly lysine, methionine and valine as an essential amino acids. Which were (0.050, 0,020 and 0.060) in blend (1) while reached (0.329, 0.124 and 0.329 g / 100g in blend (4).

Blend (1) was the highest value 1606.267 mg / 100 g in “K” mineral thus because carrot is very rich in “K” while it gradually decreased for all blends.

“Ca” and “Fe” show increase from blend (1) to blend (4) while “Zn” has a slight increase as the ratio of quinoa puree increased.

All blends revealed to a difference in T.S.S. decreased in blend (4) was 10.5 compared with blend (1) was 13.

All blends decreased in total soluble solids (T.S.S.) for example, blend (1), blend (2), blend (3) and blend (4) were decreased from 13, 11.5, 11 and 10.5 to 11, 9.5, 9 and 8.5, respectively, along the storage period.

The highest value for carotenoids was in blend (1) 8.194 mg / 100 g and decreased to 4.840 mg

/ 100 g at the end of the storage period. All blends were decreased during the storage period but blend (1) was the highest while, the lowest one was blend (4).

All blends were degraded in phenolic compounds during the storage period, but the highest one was for blend (4) was 31.667 mg / 100 g and the lowest one from blend (1) was 17.666 mg / 100 g.

Blend (1) for antioxidant was 19.566 % while, in blend (4) was 27.073 % at zero time. But at the end of the storage period in blend (1) was reached 10.980 % while, in blend (4) was 18.286 %.

The lowest "pH" score was observed 6.073 for blend (1) and highest score was observed 7.124 for blend (4) at zero time.

The ascorbic acid variations in the four blends were due to the substations of quinoa puree instead of carrot puree, thus the highest score was for blend (1) 15.733 mg / 100g and the lowest one was for blend (4) 8.396 at zero time often four months, blend (1) reached 8.268 mg / 100 g while blend (4) was 3.275 mg / 100 g.

It's clear that the best blend was blend 4 followed by blend 3 and blend 2 these results explained by the existence of quinoa puree in these blends and the feature of the antimicrobial effect in quinoa seeds.

The yeast and mold count were 2.301 log CFU/g and didn't appear after 4 months of storage, on the other hand, it reached 4.274 , 4.017and 2.602 log CFU/g in blend 1, 2 and 3, respectively and it weren't observed in blend 4 for the total count all blends didn't show microbial spots at the begging of the experiment, and starting to appear after the first month, which reached 3.301, 3.001, 2.903 and 2.778 log CFU/g in blend 1, 2, 3 and 4, respectively these percentage get increased till reached the fourth month in blend 1, 2 and 3 which were 5.544, 4.414 and 4.342 log CFU/g, respectively and 3.799 log CFU/ g in blend 4.

The results indicated that all properties were maintained good for blends (1, 2 and 3), while were accepted for blend (4). All sensory characteristics for blends were accepted during the storage period and gradually decreased but were monitored for blends (1) and (2) after four months.

Finally, it could be concluded though this study that, it is technical, economic and successful to produce product between carrot and quinoa.

ACKNOWLEDGMENTS

We are grateful to Agriculture Researcher center and our team in Food Technology Institute.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Vega Galvez A, Miranda M, Vergara J, Uribe E, Puente L, Martinez EA. Nutrition-facts and functional potential of quinoa (*Chenopodium Quinoa Willd.*), an ancient Andean grain. J. Food Science Agric. 2010;90:2541-2547.
2. FAO/OMS. Ad hoc expert committee. Energy and protein requirements. Tech. Report Series 522: FAO Nutrition Meetings Report Series No. 1973;52. Geneva: WHO/ Rome: FAO.
3. Maradini Filho AM, Pirozi MR, Borges JTS, Santana HMP, Chaves JBP, et al. Quinoa: Nutritional, functional and anti-nutritional aspects. Crit Rev Food Sci Nutr. 2017;57:1618-1630.
4. Ruales J, Nair B. Nutritional quality of the protein in quinoa (*Chenopodium quinoa*, Willd) seeds. Plant foods for Human Nutrition. 1992;42:1-11.
5. Reichert D, Tatarynovich T, Tyler R. Abrasive de-hulling of quinoa (*Chenopodium quinoa*): Effect on saponin content as determined by an adapted hemolytic assay. Cereal Chemistry. 1986;63:471-475.
6. Varriano Marston E, De Francisco A. Ultrastucture of quinoa fruit (*Chenopodium quinoa Willd.*) Food Microstructure. 1984;3:165-173.
7. Dias JCS. Nutritional and health benefits of carrots and their seed extracts. J. Food and Nutrition Sciences. 2014;5:2147-2156.
8. Zhongsu M, Ming L, Huan L, Xiuxiu S, Xinwei W. Barrier and mechanical properties of carrot puree films. J. Food and Bioproducts Processing. 2011;8:149-156.
9. A.O.A.C. Association of the official analytical chemists. Official Methods of

Analysis 17th ed. Washington, DC, USA; 2000.
10. A.O.A.C. Association of the official analytical chemists. Official Methods of Analysis 16th ed. Washington, DC, USA; 1998.
11. James C. Analytical chemistry of foods. Chap. 6, General food studies, First ed., The Alden Press, Oxford, UK; 1995.
12. Pellet PL, Young VR. Nutritional evaluation of protein foods. Published by the United Nation University; 1980.
13. A.O.A.C. Official methods of analysis of the association of official analytical chemistry. 16th ed., A.O.A.C. International, Washington, USA. 1995;1141.
14. Maurya S, Singh D. Quantitative analysis of total phenolic content in adhatoda vasica nees extracts. Int. J. Pharm. Tech. Res., 2010;2(4):24023-2406.
15. Brand Williams W, Cuvelier M, Berset C. Use of a free radical method to evaluate antioxidant activity. Lebensm. Wiss. Tech., 1995;28:25-30.
16. Yen GC, Duh PD. Scavenging effect of methanolic extracts of peanut hulls on free-radical and active-oxygen species. J. Agric. Food Chem. 1994;42:629-632.
17. Holm G. Chlorophyll mutations in barley. Acta. Agr. Scand., 1954;4:457-471.
18. Wettstein D. (1957). Chlorophyll-letale undder submikroskopischeorm wechsel der Plastiden. Exp. Cell Res., 1957; 12:427-487.
19. Lindley MG, Beyts PK, Canales B. Flavor modifying characteristics of the intense sweetener meohesperidin dihyrochalcone. J. Food Sci. 1993;58:592-598.
20. Difco. Manual dehydrates culture media and reagents for microbiological and clinical laboratory procedures. 9th Ed., Detroit, Michgan, USA;1977.
21. SAS Institute User[8] Guids: Version 9.22. SAS Institute, Inc., Cary, NC, USA; 2010.
22. Repo Carrasco Nalencia R, Hellstrom JK, Pihlava JM, Mattila PH. Flavonoids and other phenolic compounds in Andean indigenous grains: Quinoa (*chenopodium Pallidicaule)* and Kiwicha *(Amaraithus Caudatus)*. J. Food Chemistry. 2010; 120:128-133.
23. Barakate, H.; Khalifa, I.; Ghazal, G. A.; Shams, A. and Denev, P. V. (2017). Chemical composition and nutritional value of seeds from new quinoa accessions, cultivated in Egypt. J. Bulgarian Chemical communications. 2017;49:231-238.
24. Dini I, Tenore GC, Dini A. Nutritional and anti-nutritional composition of kancolla seeds : An interesting and underexploited and in food plant. J. Food Chemistry. 2005;92(1):125-132.
25. National Academy of Sciences. Under exploited tropical plants with promising economic value. RESS, Washington DC. 1975;145.
26. Prakash D, Pal M. Chenopodium: Seed protein, fraction and amino acid composition. J. International Journal of Food Sciences and Nutrition. 1998;49:271-275.
27. Bhargava A, Shukla S, Ohri D. Genetic nariability and heritability of selected traits during different cuttings of vegetables chenopodium. J. Industerial Journal Genetic Plant Breeding. 2003;63:359-360.
28. Koziol, M. Chemical composition and nutritional evaluation of quinoa (*Chenopodium quinoa* Willd.). Journal of Food Composition and Analysis. 1992; 5:35-68.
29. Abugoch Lm, Castro E, Tapia C, Anon MC, Gajardo P, Villarroel, A. Stability of quinoa flour proteins (*Chenopodium Quinoa Willd.*) during storage. J. Food Science and Technology, 2009;44:2013-2020.
30. Demir MK, Kilinc M. Utilization of quinoa flour in cookie production. J. International Food Research. 2017;24(6):2394-2401.
31. Rodriguez-Amaya, DB. Latin American food sources of carotenoids. Archivos Latinoamer icanos de-Nutricion, 1999; 49(3):745-845.
32. Saravanan K, Gadara RK, Goyal RK, Sharma RK. Studies on the storage behavior of papay jam. Hayana Journal of Horticulture Sciences. 2004;33:218-220.
33. Chen BH, Peng HY, Chen HE. Changes of carotenoids, color and vitamin A content during processing of carrot juice. Journal of Agricultures and Food Chemistry,1995;43: 1912-1918.
34. Sharma KD, Sethi V. Studies on the storage of apple from three different locations. Beverage Food World. 2000; 4:28-37.
35. Rao AV, Rao LG. Carotenoids and human health. Pharmacological Research. 2007; 55:207-216.
36. Kanwal N, Randhawa MA, Iqbal Z. Influence of processing methods and

storage on physic-chemical and antioxidant properties of guava jam. International Food Research Journal 2017; 24(5):2017-2027.
37. Cocetta G, Baldassarre V, Spinardi A, Ferrante A. Effect of cutting on ascorbic acid oxidation and recycling in fresh-cutbaby spinach (Spinaciao leracea L.) leaves, Post. Biol. Technol. 2014;88:8-16.
38. Sabeera M, Waqas NB, Nuzhat N, Masoodi FA, Mohd Munaff BH, Rafiya B. Effect of storage on physicochemical, microbial and anti-oxidant properties of pumpkin (cucurbita moschata) candy. J. Food Science and Technology; 2016.
39. Rani U, and Bhatla BS. Studies on pear candy processing. J. Indian Food Packer. 1985;39:40-46.
40. Sandhu, GS. Development of sugar coated candied products (MSC thesis). Punjob Agriculture Universty, Ludhlana; 1994.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/66376