J. Food and Dairy Sci., Mansoura Univ., Vol. 10(8): 281- 288, 2019

Utilization of Husk Tomato Fruit Seeds Powder in some Foodstuff

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ABSTRACT

Husk tomato (*Physalis pruinosa* L.) is a member of the family, *Solanaceae*, seeds of husk tomato were analyzed and characterized in terms of physical properties, physico-chemical characteristics, chemical analysis, mineral content and technological utilization in preparation of products. The percentage of seeds approximately 30% of the full fruit. Seeds of husk tomato were found to be a very well basis of protein, crude fiber, carbohydrate, total phenol, in addition to antioxidant activity (%).The seeds have a great content of potassium (495.20 %) and could be an abundant source of phosphorus (123.74%) and iron. Considerable amounts of the amino acid, as the glutamic acid (23.21%), aspartic acid (18.67%), arginine (13.10%), proline (7.01%), phenylalanine (6.00%) and valine (5.201%) are the major amino acid. The results also showed *in-vitro* protein digestibility(%), water absorption (g/g) sample, oil absorption (g/g) sample, foam capacity (%), emulsion stability (%) and dispersibility (cm^3) were 85.98 , 2.55, 0.56, 58.50, 52.75and 4.92, respectively. Generally, Linoleic and oleic acids are the major fatty acids and comprised about 84.41% of the total fatty acids content. Moreover, the peroxide value was 2.02 ($meqo_2$/Kg oil) as well as the iodine value was 100.72. Lovibond colour yellow, red as well as blue were 41.00, 4.10 and 0.2, respectively. The different products prepared from seeds of husk tomato were acceptable and having a good specification as a result of the sensory evaluation.

Keywords: Seeds of husk tomato, physical properties, chemical analysis, oil characteristics and technological utilization.

INTRODUCTION

Husk tomato (*Physalis pruinosa* L.) is from within the family, *Solanaceae*, it have different names such as husk tomato, strawberry tomato, tomatillo fruit, golden berry or winter cherry (Swartwood and Van Eck, 2019) and commonly known in Egypt as harankish.

It has long since a minor fruit of the Andes and has also been grown in north and East Africa , India , Australia and great Britain and now here became a major crop .it is one of the most unusual and pretty plants which often appears in illustration fairy stories is the Chinese lantern (*physalis alkekengie*). It is local to the region extending from central Europe to the Urals. It is frequently cultivated in gardens for decoration. The juice of berry is slightly acidic, but agreeable to the taste and quite great in vitamin content (Hemalatha *et al.*, 2018).

Husk tomato grown in semi- tropical regions and it has been stated that harankish in cultivated to eat it fruit fresh / raw because of its high nutritional value, its importance in the draining of bile juice and its importance role in activation of liver functions .The plant was formally highly prized by the Arab physicians as a medical herbal for treating kidney disease and diseases of urinary passage. Today, it is applied in homeopathy for the same purpose (Naumova *et al.*, 2019).

Husk tomato in cultured in Egypt in limited areas near the big cities, also it can be cultured in the south of Elwady and in the new repaired region in toshki. Morethan 300 areas are cultivated with husk tomato in Egypt. Harankish in usually used for local consumption as a snake food or for exportation. The fruit of harankish is small round in shape yellow to yellow greenish in color 2cm in diameter covered with thin husk and containing a large number of off white seeds (Curi *et al.*, 2018).

The fruits are perishable having great moisture which leads to a rapid spoilage if it doesn't produced .Additionally, it has a short marketing season start from October to February. Due to its very acceptable and popular sweet taste with acidic nature its high nutritive value and its medical importance it consumption in Egypt is starting to increase. Moreover, now a day many factories have been processing husk tomato into different foodstuffs as jelly and jam you can see these products on the shelf in the markets. Seeds of husk tomato are represent approximately 30% of the fruits. Huge quantities of seeds are wasted from this manufacturing in addition to no awareness about their utilization in any valuable way (Etzbach *et al.*, 2018 and Guimaraes *et al*., 2019).

Fortification of food is a very vital process, definite as the adding of one or extra nutrients rich constituents together aimed to progress nutritionally of food, function properties as well as sensory assessment of the last product. Black rice is used as a component in meat, snacks as well as sweets. It is assessed to be a functional food since it has phenolic complexes, particularly anthocyanins also, it is a decent basis of antioxidant besides inhibition of fat oxidation. Owing to the black rice assessment as health food. Black rice has a total of nutritional benefits over common rice that vitamins, insoluble fiber, minerals, protein besides good biological value (American Culinary Federation Education Foundation 2016, Klunklin and Savage 2018 and Irsalina *et al.*, 2018). The anthocyanins display a vital advantage as antioxidant activity, black rice having high anthocyanin and polyphenol contents (325.09 mg/100g and 76.51mg GAE/g), respectively (Lotfy and Anis 2015). Little data are valuable in the literature regarding the processing of seeds. Consequently, the current search was on conducted to assess the chemical besides technological priorities of husk tomato seeds besides its application in some functional food products.

MATERIALS AND METHODS

Materials:-

Husk tomato:

The (*Physalis pruinosa* L.) fruits used in the current search were obtained from Alexandria market, Alexandria .Egypt in season 2017. The fruits were ripe besides orange or yellow in colour .The fruits are of a local variety (Ballady) covered with husk, Ca.2 cm diameter. the fruits were sorted (To remove any foreign materials and defected fruits), husked and then washed with water .The seeds

were collected after juice extraction, washed thoroughly then dried carefully in a circulating air oven at 45 ºC, constant weight. Cleaned dried husk tomato seeds were milled using Kenwood mixer (Model BL350, PK100/AD, England) the milled powder was sieved through an 80 mesh sieve and the husk tomato powder was packed in Kilner jars and kept at 4 ºC until use .

Black rice flour:

Black rice was obtained from the Rice Research and Training Center (RRTC), Sakha, Kafr Elsheikh Governorate, Egypt. Rice grains were ground, then passed through an 80 mesh sieve.

Chemicals and reagents:

Solvents, chemicals, and reagents were obtained from El-Gomhouria Company, Alexandria , Egypt, and Sigma – Aldrich (Germany). All chemicals in addition to reagents used were of analytical grade.

Other ingredient:

Wheat flour, meat and other basic baking ingredients, sugar, powdered milk, eggs, baking powder, salt besides others were procured from the local market in Alexandria, Egypt.

Methods:

Physical methods:

According to Mackinnery and Little (1962), colour of husk tomato seeds dried were assessed using Lovibond Schofield Tintometer type IA.

Physical and technological properties of husk tomato fruits and its seeds using weight of seeds, 100 seeds mass, bulk density besides seed dimensions (thickness, width and length) as described by the methods reported by Calisir *et al.*, (2005).

Technological methods:

Separation and preparation of husk tomato seeds and its milled powder (Fig.1).

Fresh husk tomato fruit were sorted, husked, sorted again, washed, pulped using fruit pulper (Abou-Gharbia and Abou-Tour, 2001). The resulted seeds and skin mixture were submerse in water and the floated skin was separated and discarded. The water was decanted/ drained (the sedmented seeds) and the lifted seeds were washed several times to remove any juice residues. The seeds were dried at 45 ºC about 15 hrs. until constant weight, in a thermostatically controlled hot air oven with air van. The dehydrated seeds were ground electrically to pass through 80 mesh sieve to obtain husk tomato seeds milled powder. The obtained powder was packed in air- tight kilner jar as well as stored in a refrigerator at 4 ºC until use.

Preliminary study:

In the preliminary study, several levels for fortification were made by husk tomato seeds powder (HTSP) 1, 3, 5, 7, 9 and 11%. Similarly, different levels of black rice flour (BRF) were made 2, 4, 6, 8, 10 and 12%. Blends of husk tomato seeds powder as well as black rice flour were made according to which the best results of the above sensory values were selected based on the quantitative sensory values, (Stone and Sidel, 1992).

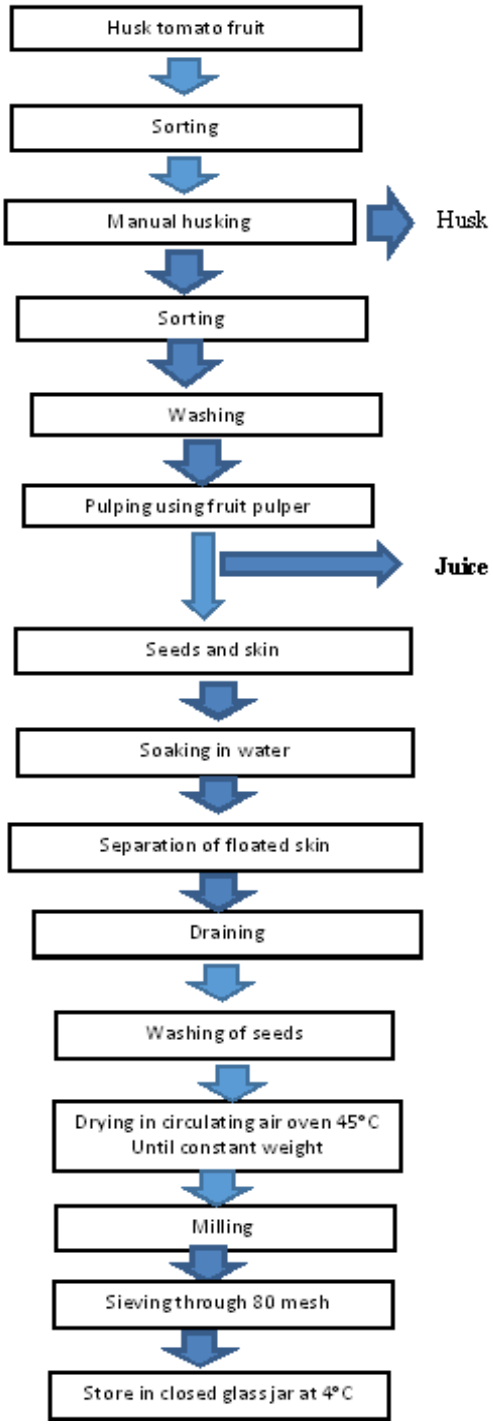

Fig. 1.Separation of husk tomato seeds and preparation of powder.

Preparation of burger:

Preparing of the burger was processed according to Aleson-Carbonell *et al.*, (2005). The components of the burger beef meat, ice water, salt in addition to white paper for each 100 g meat were blended, then mixed with the 5% Husk tomato seeds powder (HTSP) + 6 % Black rice flour (BRF) (B1), besides, control (B).

For each sample mixed separately for 5 min at medium speed, using a cutter to obtain homogeneous blend. This combination was shaped by a commercial burger maker into disc pieces of 50 g besides a diameter of 9 cm and a thickness of 1 cm to obtain a burger. Plastic

packaging film was used to assistance keep the shape of the burger prior to freezing and stored at -18 ˚C.

Preparation of Pizza:

Pizza were processed as described by Singh and Goyal (2011) .Pizza was made from the following constituents: wheat flour, (72% extraction), baking powder, sunflower oil, skim milk powder, egg (whole), g salt, shredded mozzarella cheese, diced green pepper, diced tomato, small quantity of tomato paste, diced pickled olive and sliced pastrami. The effect of adding 7% Husk tomato seeds powder (HTSP) + 8 % Black rice flour (BRF) (Z1) with wheat flour on pizza besides, to control (Z), and quality was studied.

Sugar, salt, flour and baking powder were incorporate in a dish. In a separate dish, milk, oil, and egg were whisked together, then poured into the dry ingredients stirred just until dry ingredients were moistened The mixture was poured into a well-greased pan. Tomatoes, green pepper, olive, pastrami, and mozzarella cheese were sprinkled on the top of the batter and baked in a preheated oven at 180˚C for about57 min.

Chemical methods:

Determination of proximate composition. The samples were investigated for protein, moisture, ash, fat in addition to fiber by the methods of AOAC (2010). Carbohydrates were calculated by difference, FAO/WHO (1998) as = 100 - (protein + fat + moisture + ash) in 100 g of food. Caloric values were calculated as described by FAO/WHO (1974). Caloric value in Kcal/100 g = 4(protein% + carbohydrates %) + 9 (fat %). Total tocopherols were determined calorimetrically using a rapid method according to Tsen (1961). Phenolic substances as mg Gallic acid equivalent (GAE/100g) was assayed calorimetrically as described by Hagerman and Bulter (1978). Antioxidant activity was measured by the N, N–dimethyl–P–phenylenediamine dihydrochloride (DMPD) according to Fogliano *et al.*, (1999).

Some minerals as (Fe, K, Na and P) were measured according to AOAC (2010) by Perkin Elmer Atomic Absorption Spector photometer (M- 2380).Moreover, K besides Na was measured by flame photometer (PE-England). On the other hand, Phosphorus was determined by the phosphomolybdovanate method (AOAC, 2010). Using pepsin then, pancreatin as a proteolytic enzymes with husk tomato seeds powder to determine *In vitro* protein digestibility according to Prakash and Prakash (1999). Oil in addition to water absorption as functional properties described through AOAC (2010).Foam capacity , powder dispersibility and emulsion stability of husk tomato seeds powder were determined by the methods described through Del Rosario and Flores (1981), Mora-Escobedo *et al*., (1991) and Chau and Cheung (1998).

Determination of amino acid profile:

Amino acid of sample hydrolysates were prepared following the method of Spackman *et al.*, (1958) by using (SYKAM S 433 Amino Acid Analyzer).

Tryptophan was determined calorimetrically in the alkaline hydrolysate according to Blauth et *al.*, (1963).

Determination of fatty acid profile:-

After total lipids were extracted with a mixture of chloroform, methanol (2:1, v/v) as outlined by the procedure of Folch (1957). Fatty acid methyl esters of oil samples were prepared as described by Radwan (1978) in screw cap vial using 1% H_2SO_4 in methanol under stream of nitrogen gas. The closed vials were heated in an oven at 90 °C for 90 min. Gas chromatographic (GC) investigation was carried out by ACME model 6100 GC (Young LTN Instrument Co., Korea), capillary column with a 0.25 – mm i.d. and 0.2 - µm film thickness (Supelco Bellefonte, PA), fitted with a split/splitless injector and FID detector. Standard fatty acid methyl esters were used for identification.

Physico-chemical characteristics of husk tomato seed oil:

A quantity of powder was subjected to extraction by chloroform: methanol (2:1v/v) according to Folch *et al*., (1957)and using rotary evaporator at 40°C to remove the solvent as well as the oil stored in a sealed glass at -18°C up to analysis.

Refractive index (RI) at 25°C, specific gravity (sp. Gr) at 25°C, acid value (mg / g sample),iodine value (IV), saponification value (SV), peroxide value (PV as $meqo_2$/Kg oil), free fatty acids (as % oleic acid), unsaponifiable matter (%) as well as colour were determined according to AOCS (1997) (in cell) of seed oil by a Lovibond tintometer (Model E, England).

Sensory evaluation of products:

The products were introduced to the panelists to evaluate the samples, colour, odour, texture and overall acceptability using a numerical (hedonic) rating of 1-9 (1= dislike very much, 9= like very much) according to Crehan *et al*., (2000) and Pacheco de Delahaye *et al*., (2005). The samples were randomly introduced to the panel to avoid panelist bias. The panelists were requested to check the properties which finest described the samples as well as to score them for acceptability.

Statistical analysis:

All the analyses were carried out and expressed as mean and standard deviation (SD). Data were statistically analyzed by analysis of variance (ANOVA) and significant differences were identified by Duncan's Multiple Range test ($p \leq 0.05$), (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Some physical and technological properties of husk tomato fruits and its seeds.

As displayed in Table (1) the average number of seeds per fruit was 200 which is a little bit too much. Moreover, the percentage of seeds approximately 30% of the full fruit while the seed and skin about 35% of the whole fruit. Seed index (g/100 seeds) and bulk density (g/cm^3) were 0.17 and 0.77, respectively. According to Abou-Gharbia and Abou-Tour (2001), the number of seeds for husk tomato fruits ranges 180 -220, while the weight of 1000 seeds is about 1.6g. Bulk density is a means to know the proportionality of flours for food preparations. The assessment of the bulk density was low (0.77g/cm3). Moreover, it is required in baby nutrition and in the preparation of supportive eating (Nelson-Quartey *et al*., 2007). As showed in Table (1), presents the Lovibond reading of seeds, the value of yellow, red and blue were 5.5, 1.25 and 0.44, respectively and also, the yellow colour was the main whereas the red colour was the

complementary one. The similar result is nearly close to Abou-Gharbia and Abou-Tour (2001) and El Sheikha *et al*., (2008).

Table 1. Some physical and technological properties of husk tomato fruits and its seeds.

property	Value
(a)physical properties	
Number of fruits per kilogram	240±1.74
Fruit average weight (g)	4.1±1.30
Average diameter (cm)	2.0±0.14
Number of seeds per fruit	200±12.0
Seed index (g/100 seeds)	0.17±0.10
Bulk density (g/cm^3)	0.77±0.16
Length (mm)	1.1±0.13
Width (mm)	1.0±0.11
Thickness (mm)	1.0±0.12
Colour	
Visually	Light brown
Lovibond	
Yellow	5.5±0.11
Red	1.25±0.07
Blue	0.44±0.09
(b) technological properties	
Husk (%)	5.46±0.20
Yield after husking (%)	94.54±1.18
Juice (%)	65.0±1.07
Seeds and skin (%)	35.0±1.40
Seeds (%)	30±1.14
Skin (%)	5±0.10
Juice/seeds ratio	2:1+0.20

Mean values represent ± Standard Deviation values.

Chemical analysis of husk tomato seeds powder.-

Chemical analysis of seeds powder from husk tomato, as displayed in Table (2) containing the percentage of moisture, crude protein, crude lipid, total ash, carbohydrate (by difference %), crude fiber, energy value (Kcal/100g), total phenol content (mg GAE/100g), total tocopherols (%) in addition to antioxidant activity (%) were 7.85, 15.62, 18.93, 2.85, 54.75, 33.52, 451.85, 28.10, 0.08 and 55.15, respectively. These results were nearly close to those mentioned by Cordenunsi *et al*., (2002),Abou-Gharbia and Abou-Tour (2006) and Hassanien *et al*., (2011). The results in Table (2) also show the seeds powder is considered as a determined as a very well source of protein content, carbohydrate, crude fiber, total phenol content (mg GAE/100g) as well as antioxidant activity (%) (Hassanien *et al*., 2011). The same author reported that the gooseberry have a high dietary fiber content. The moisture in seeds powder from husk tomato was lower 14% as recommended moisture contents (14%) for kept storage representative extended storage. Comparable results of chemical analysis through Marques *et al*., (2013) of ash as well as protein content in powder from golden berry were 2.64% as well as 14.55%, respectively, The chemical composition varies due to the surrounding environmental conditions, irrigation, fertilization, maturity, analysis method, and other factors (Kaushal *et al*., 2012). Goldenberry powder may supply useful result to the human body (Institute Of Medicine, 2005), consequently, it can be applied in some food for personalized nutrition.

Table 2. Chemical analysis of husk tomato seeds powder, (On wet weight basis).

Component (%)	Value
Moisture	7.85±0.18
Crude protein (N X 6.25)	15.62±0.34
Crude lipid	18.93±0.86
Total ash	2.85±0.32
Carbohydrate*	54.75±0.65
Crude fiber	33.52±0.37
Energy value (Kcal/100g)	451.85±0.54
Total phenol content (mg GAE/100g)	28.10±0.23
Total tocopherols	0.08±0.28
Antioxidant activity (%)	55.15±0.67

Mean values represent ± Standard Deviation values.
Carbohydrate content was calculated by difference. *

Some minerals content of husk tomato seeds powder.-

Concentrations of nutritive some minerals in husk tomato seeds powder are displayed in Table (3).The elements are arranged in a decreasing order based on their concentrations (mg/100g) as follows: potassium, sodium, phosphorus besides iron were 495.20, 129.56, 123.74 as well as10.81, respectively. Related data were described by Hassanien *et al*., (2011) and Marques *et al*., (2013) for acerola flour. Puente *et al*., (2011) displayed the minerals have a vital part in several purposes in the body. It can be concluded husk tomato seeds powder as a decent source of some minerals content.

Table 3. Some minerals content in husk tomato seeds powder.

Elements	Value (mg/100g)
K	495.20±0.90
Na	129.56±0.74
P	123.74±0.25
Fe	10.81±0.61

Mean values represent ± Standard Deviation values.

Amino acid profile of husk tomato seeds powder. -

Amino acid (A. A) profile of husk tomato seeds powder are displayed in Table (4). The data showed that the glutamic acid (23.21%) , Aspartic acid(18.67%), Arginine(13.10%), Proline(7.01%), Phenylalanine(6.00%) and Valine(5.20%) are the major A. A. Considerable amounts of Threonine, Alanine, Tyrosine, Leucine, Isoleucine, Lysine and Serine are also, found in the husk tomato seeds powder. The similar result is nearly close to Abou-Gharbia and Abou-Tour (2001). Comparing with the FAO/WHO/UNU (1985) pattern, greatest of the essential amino acids are close to the suggested level in the FAO/WHO/UNU (1985) pattern. These results displayed that seeds powder could be a decent possible source of essential A. A.as well as general amino acid.

***In -vitro* protein digestibility and functional properties of husk tomato seeds powder.**

The *in-vitro* protein digestibility of husk tomato seeds powder is displayed in Table (5). The obtained results illustrated that the digestibility was 85.98%. This character is comparable to those of legumes but lower than those of animal protein (Diez and Alvarez, 2001). The results in Table (5) also show water absorption (g/g) sample, oil absorption (g/g) sample, foam capacity (%), emulsion stability (%) and dispersibility (cm^3) were 2.55, 0.56, 58.50, 52.75and 4.92, respectively. These results

were inside the extent established by Appiah *et al.,* (2011). Protein is the main substance affecting of oil absorption by hydrophobic and hydrophilic portions (Tharise *et al.*, 2014). Water absorption acting a vital part in the texture value of a varied variety of foods, particularly meat foodstuffs besides baking applications (Niba, *et al.*, 2001). Moreover, Aremu, *et al.*, (2006) stated that the oil absorption is vital to rises the mouth-feel of eating. Foam capacity emulsion stability and dispersibility are influenced by some characteristic, as viscosity, protein as well as processing procedures (Kaushal *et al.*, 2012). From the above, it is clear that the seeds powder has a decent value so, it is fit to fortification the products of baking, meat as well as baby food.

Table 4. Amino acid profile of husk tomato seeds powder.

Amino acids	Content (g/100g)	FAO/WHO/UNU* PATTERN(1985)
Lysine	2.55±0.29	
Methionine	1.10±0.68	
Cystine	0.13±0.36	
Threonine	4.20±0.59	5.08
Tryptophan	1.80±0.21	2.5
Histidine	1.20±0.54	2.5
Leucine	2.92±0.78	3.4
Isoleucine	2.60±0.64	1.4
Phenylalanine	6.00±0.83	1.9
Tyrosine	3.10±0.21	4.2
Valine	5.20±0.53	2.8
Arginine	13.10±0.24	6.3
Alanine	2.20±0.79	
Aspartic acid	18.67±0.94	3.5
Glutamic acid	23.21±0.89	2.0
Glycine	1.12±0.37	
Proline	7.01±0.65	
Serine	1.65±0.32	

Mean values represent ± Standard Deviation values.
Pattern for 2-5 years (childhood)*.

Table 5. *In -vitro* protein digestibility and functional properties of husk tomato seeds powder.

Parameters	Value
In - vitro protein digestibility %	85.98± 0.26
Water absorption (g/g) sample	2.55±0.17
Oil absorption (g/g) sample	0.56±0.11
Foam capacity (%)	58.50±0.50
Emulsion stability (%)	52.75±0.43
Dispersibility (cm^3)	4.92±0.13

Mean values represent ± Standard Deviation values.

Fatty acid profile of husk tomato seeds powder.

Fatty acid profile of husk tomato seeds powder is displayed in Table (6). The unsaturated fatty acid represent 87.54%. The main unsaturated fatty acid is linoleic acid followed by oleic acid were 64.33% and 20.08%, respectively. On the other hand, saturated fatty acids represent 12.76% composed mainly palmitic acid followed by arachidic acid were 5.42% and 3.00%, respectively. The similar result is nearly close to Ramadan and Moersel, (2009) in goldenberry.The presence of the high of the unsaturated fatty acid namely linoleic acid and oleic acid proves the highly nutritious (Ramadan and Moersel, 2007) which may be useful in various diseases as cholesterol as well as atherosclerosis (Oomah *et al*.,2000).

Table 6. Fatty acid profile of husk tomato seeds powder.

Fatty acid	Content (%)
Myristic c14:0	0.54±0.31
Palmitic c16:0	5.42±0.63
Palmitoleic c16:1	2.41±0.87
Stearic c18:0	2.75±0.52
Oleic c18:1	20.08±0.36
Linoleic c18:2	64.33±0.75
Arachidic c20:0	3.00±0.53
Gadoleic c20:1	0.72±0.12
Behenic c22:0	0.55±0.23
TSFA (S) **	12.76±0.18
TUFA(U) ***	87.54±0.45
U/S Ratio	6. 86±0.87

Mean values represent ± Standard Deviation values.
****Total saturated fatty acids.**
*****Total unsaturated fatty acids.**

Physico-chemical properties of husk tomato seeds oil.

Physico-chemical properties of husk tomato seeds oil are displayed in Table (7). The refractive index was 1.3326, which was nearby of common oils as soybean oils.

Acid value 1.33 (mg / g sample) still below the determined equal (4.0 mg KOH/ g crude oils) permitted through Codex Alimentarius Committee, (1999). The free fatty acids effect by some impurities which leads to rising the free fatty acid (Nkafamiya *et al*., 2010). The peroxide value was 2.02 ($meqo_2$/Kg oil), still below the determined equal (less than 10 $meqo_2$/Kg oil) permitted through Codex Alimentarius Committee, (1999). Saponification value was (155.83 mg KOH/g oil) which was nearby of common oils (Nkafamiya *et al*., 2010). The iodine value of was 100.72, which was in the variety of 94 to 126 g of I_2/100 g for sunflower in addition to cotton oils (Codex Alimentarius Committee, 1999). Lovibond colour yellow, red as well as blue were 41.00, 4.10 and 0.2, respectively, indicating that the yellow colour was the predominant whereas the red colour was the complementary one. The similar result is nearly close to Hsu and Yu (2002) for some common oils as sunflower as well as olive.

Table 7. Physico-chemical properties of husk tomato seeds oil.

Property	Value
Refractive index (25°C)	1.3326±0.11
Specific gravity (25°C)	0.8426±0.15
Acid value (mg / g sample)	1.33±0.16
Free fatty acids (as % oleic acid)	0. 17±0.35
Peroxide value ($meqo_2$/Kg oil)	2.02±0.51
Saponification value	155.83±0.42
Iodine value	100.72±0.61
Unsaponification matter (%)	0.725 ±0.08
Lovibond colour	
Yellow	41.00±0.16
Red	4.10±0.14
Blue	0.2 ±0.06

Mean values represent ± Standard Deviation values.

Sensory evaluation:

Preliminary study:

The consequence of the initial investigation, several levels for fortification were made by husk tomato seeds powder (HTSP) 1, 3, 5, 7, 9 and 11%.

For quantitative sensory assessment methods was carried out according to Stone and Sidel (1992), were selected levels of 7and 9% for pizza as well as 5 and 7% for burgers. Similarly, different levels of black rice flour (BRF) were made 2, 4, 6, 8, 10 and 12% based on quantitative sensory evaluation ,both levels 8 and 10% for pizza were selected, while 6 and 8% with burgers.

Blends of husk tomato seeds powder as well as black rice flour were made according to which the best results of the above sensory values were selected based on the quantitative sensory values. The results for mixes were selected 7% husk tomato seeds powder (HTSP) with 8% black rice flour (BRF) for pizza, while for the burger was 5% Husk tomato seeds powder (HTSP) with 6% black rice flour (BRF) as the best mixes in both applications.

Sensory evaluation of products:-

The sensory evaluation of products varieties includes properties color, taste, odor, texture, overall acceptability as described by Ghufran *et al.*, (2009). Low bulk density of husk tomato seeds powder is required for infant food as nutritionally and in the preparation of supportive eating (Nelson-Quartey *et al*., 2007). Husk tomato seeds powder having both nutritionally as unsaturated fatty acid namely linoleic and oleic acid as well as functional properties such as water and oil absorption, water absorption acting a vital part in the texture value of a varied variety of foods, particularly meat foodstuffs besides baking applications (Niba, *et al.*, 2001). Moreover, (Aremu, *et al.*, 2006) stated that the oil absorption is vital to rises the mouth-feel of eating.

Sensory assessment of burger are displayed in Table (8). Data displayed that there was a significant difference ($p<0.05$)for colour, odour, texture besides overall acceptability among burger treatment with 5% husk tomato seeds powder (HTSP) + 6 % Black rice flour (BRF) (B1) besides the control. (B). Burger (B1) was well accepted and displayed a higher score of sensory properties compared with control (B). This is due to the characteristics of both husk tomato seeds powder and black rice flour. Black rice flour has high antioxidants (Kushwaha 2016) as well as its other properties, which gives high susceptibility because it maintains the state or product most acceptable to the consumer besides the feeling of freshness in the product. Moreover, this fortification might potentially improve the sensory properties of products .The similar result is nearly close to Crehan *et al*., (2000) for frankfurters, Aleson-Carbonell *et al*.,(2005) with the burger other than Gonzalez-Aguilar *et al*.,(2008). As for the pizza, as displayed in Table (9), the results displayed that they are in the same trend, as both 7% husk tomato seeds powder + 8 % black rice flour (Z1)were more acceptable than the control (Z) according to the above-mentioned properties and reasons. The similar result is nearly close to Pacheco de Delahaye *et al*., (2005), Singh and Goyal (2011) and Limongi *et al*., (2012).

Table 8. Sensory evaluation of burger by different components.

Sample	Colour	Odour	Texture	Overall acceptability
B	7.8±0.46 [a]	7.9±0.95 [a]	7.5±0.76 [a]	7.3±0.63 [a]
B1	8.4±0.21 [b]	8.5±0.73 [b]	8.3±0.35 [b]	8.4±0.54 [b]

Mean values represent ± Standard Deviation values
Mean values with different superscripts within the same column are significantly different ($p \leq 0.05$)
(B) Control
(B1) 5% Husk tomato seeds powder (HTSP) + 6 % Black rice flour (BRF).

Table 9. Sensory evaluation of pizza by different components.

Sample	Colour	Odour	Texture	Overall acceptability
Z	8.0±0.65 [a]	7.7±0.70 [a]	7.6±0.47 [a]	7.4±0.34 [a]
Z1	8.6±0.81 [b]	8.6±0.22 [b]	8.4±0.79 [b]	8.6±0.68 [b]

Mean values represent ± Standard Deviation values
Mean values with different superscripts within the same column are significantly different ($p \leq 0.05$)
(Z) Control
(Z1) 7% Husk tomato seeds powder (HTSP) + 8 % Black rice flour (BRF).

CONCLUSION

The above results displayed that seeds of husk tomato were high in its nutritive value, mineral such as potassium besides phosphorus. Seeds having an abundant amount of the amino acid besides fatty acids content also, a good of functional properties. So, the different products could be successfully prepared from seeds of husk tomato were acceptable and having a good specification.

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استخدام مسحوق بذور ثمار الحرنكش في بعض المواد الغذائية

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ثمار الحرنكش (*Physalis pruinosa* L) بتبع العائله *Solanaceae* ، وقد تم دراسه بذور ثمار الحرنكش من حيث الخواص الفيزيائية والتحليل الكيميائي والمحتوى المعدني وكذا الاستخدام التكنولوجي في إعداد بعض المنتجات. تبلغ نسبة البذور حوالي ٣٠٪ من الثمار بأكملها. ووجد ان بذور ثمار الحرنكش مصدرا جيدًا للبروتين والألياف والكربوهيدرات والفينول الكلي بالإضافة إلى نشاط مضادات الأكسدة (٪) ، وكذا تحتوي البذور على نسبة عالية من البوتاسيوم (٤٩٥.٢٠ ٪) وايضا الفوسفور (١٢٣.٧٤ ٪) والحديد. هناك ايضا نسب عاليه من الأحماض الأمينية ، مثل حمض الجلوتاميك (٢٣.٢١ ٪) ، حمض الأسبارتيك (١٨.٦٧ ٪) ، أرجينين (١٣.١٠ ٪). أظهرت النتائج أيضًا أن هناك بعض من الخصائص الوظيفيه الجيده مثل امتصاص الماء (g / g) و امتصاص الزيت (g / g) كانت ، ٢.٥٥ و ٠.٥٦ على التوالي. بشكل عام فإن الأحماض اللينوليك والأوليبك هي الأحماض الدهنية الرئيسية وتمثل نسبه حوالي ٨٤.٤١٪ من إجمالي محتوى الأحماض الدهنية. علاوة على ذلك كان قيمة البيروكسيد ٢.٠٢ ($meqo_2$ / Kg oil) وكذلك قيمة الرقم اليود ١٠٠.٧٢. كان لون لوفيبوند الأصفر والأحمر والأزرق ٤١.٠٠ ، ٤.١٠ و ٠.٢ ، على التوالي. اظهرت نتائج الاختبارات الحسيه للمنتجات المختلفة المحضره باستخدام مسحوق بذور ثمار الحرنكش بنسب مختلفه انها مقبولة وذات مواصفات جوده عاليه.