NUTRITIONAL PROPERTIES OF SOME FUNCTIONAL CEREALS' EXTRACTS AND FRUIT JUICES

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Nutritional properties of some functional cereals' extracts and fruit juices

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Abstract:

The present study aimed to determine the chemical composition, vitamins, minerals and antioxidant activities of barley water extract, flaxseed water extract and juices of fruits (pumpkin, apple, pineapple and pomegranate). Results showed that flaxseed extract recorded the highest protein, fat, ash and fiber contents, while barley extract recorded the highest carbohydrate content. Pomegranate recorded the highest protein, fat and carbohydrates, whereas pumpkin recorded the highest ash content and pineapple juice recorded the richest fiber content comparing with other fruit juices. Results show that pumpkin juice recorded the most abundant content of V.A and vitamin E, while the largest V.C content was recorded for pineapple and the largest V.K content was found in pomegranate juice. Flaxseed extract had rich content of Ca, Mg, K, P, Fe and Mn, while barley extract was rich in Zn and Se. Meanwhile pumpkin juice scored the major content of Ca, K, P, Fe and Zn comparing to other fruit juices. While pineapple juice recorded the highest Mn content but the largest Se content was recorded for pomegranate juice. As for Mg and Zn, pumpkin and pomegranate recorded the highest content comparing to other fruit juices. Flaxseed extract was the richest in omega 3, omega 6 and total phenols, also barley recorded high percentages of omega 3 and omega 6. Among fruits, pineapple juice recorded the highest omega 3 content followed by apple and pomegranate juices. While pomegranate recorded the highest omega 6 content, and the largest total flavonoid content was recorded for apple juice. Pumpkin juice was the richest in beta-carotene and total phenol when compared to other fruit juices. In conclusion; food products with more functional components and acceptability can be obtained by mixing functional cereals with functional fruits.

Key words: Barley extract, Flaxseed extract, pumpkin, apple, pineapple and pomegranate

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Introduction

According to **Shaikh *et al*. (2020),** flaxseed is an oil seed that is used to make a variety of healthy food products because it is a rich source of the necessary amino acid alpha-linolinic acid. The results showed that the flaxseed's color was brown and that its length, width, and thickness were 5.20 mm, 2.80 mm, and 0.80 mm. Further chemical composition analysis revealed that the product had a moisture content of 5.6%, a fat content of 35.2%, a protein content of 20.16%, an ash content of 2.6%, a fiber content of 6.3%, and a carbohydrate content of 25%.

Tang *et al*. (2020) said that flaxseed can be taken directly in whole or milled form. Currently, whole or milled flaxseed has been added as a useful additive to many common goods in order to increase the nutritional value of food products. However, flaxseed can drastically alter physical and chemical characteristics like texture, sensory, and other aspects of food products. According to **Zhu *et al*. (2020)**, dietary intervention is essential for the management of diabetes. The omega-3 polyunsaturated fatty acid (PUFA) flaxseed oil (FO) is rich in -linolenic acid (ALA), which has been shown to be beneficial for chronic metabolic disorders. **Saka *et al.* (2022)** mentioned that the importance of using flaxseed as a grain in a diet has lately been highlighted because of the nutritional advantages of its components, particularly lipids, proteins, lignans, and fibre, as well as their usage in the creation of numerous value-added products. **Waston and Preedy (2019)** reported that the primary cause of death globally and for those who have type 2 diabetes is cardiovascular disease. The world's oldest crop, *Linum usitatissimum*, which produces flaxseed, has a special combination of bioactive ingredients. No other natural food source combines high levels of protein, fiber, and magnesium with an active dose of lignans and omega-3 fat in a single meal. These medications reduce the risk of diabetes and cardiovascular disease, according to substantial mechanistic evidence.

Collar and Angioloni (2014) observed that numerous investigations have shown that barley can be found in a wide variety of processed foods, including Asian noodles, biscuits, cookies, and muffins as well as numerous

types of bread. **Das *et al*. (2016)** mentioned that the main components of barley are carbohydrates with low fat, protein, minerals, vitamins especially vitamin E, dietary fiber, and antioxidants predominantly polyphenols. **Guo *et al*. (2020)** stated that the nutritional constituents of barley consist of health-promoting starch (65%–68%), protein (10%–17%), free lipids (2%–3%), β-glucans (4%–9%), and minerals content ranges from 1.5%–2.5%, respectively. Moreover, total dietary fiber varied from 11%–34% among which, 3%–20% is soluble dietary fiber.

Idehen *et al*. (2020) mentioned that obesity, race, inactivity, heredity, and other variables all increase the risk of having T2D. The risk of obesity and type 2 diabetes has been shown to decrease with increased whole-grain (WG) eating. Barley stands out among WGs in terms of fiber content, particularly the soluble fiber beta-glucan (-glucan), an active ingredient credited with this effect. The majority of the significant phytochemicals found in barley are entangled with its fiber and are referred to have positive effects on glycemic response.

Attarde *et al*. (2010) reported that pumpkin (*Cucurbita maxima*) contains phenolic compounds, carotenoids and terpenoids, which are responsible for antioxidant activities. **Yadav *et al*. (2010)** stated that pumpkin is regarded as a nutritious and useful food because of its great supply of key antioxidants such carotenoids, lutein, zeaxanthins, and other polyphenolic compounds as well as vitamins, minerals, pectin, and dietary fiber. **Treanore *et al*. (2019)** reported that pumpkin is an annual plant of the Cucurbitaceae family. Pumpkins contain a large number of nutrients, including vitamin phenolic compounds, carotenoid polysaccharide pectin, and mineral salts with anti-cancer, blood sugar-lowering, and lipid-lowering characteristics. **Bemfeito *et al*. (2020**) said that furthermore, pumpkin contains significant amounts of protein, soluble and insoluble fibers, carotenoid pigments and other bioactive compounds such as phenols. **Ceclu *et al*. (2020)** stated that pumpkin is a versatile vegetable that is used in a variety of foods and drinks, including cereal, cakes, muffins, and dairy products, among others. Along with this, the usage of pumpkin byproducts in food composition has grown due to their significant nutritional worth and

attention to human health. **Sharma *et al*. (2020)** observed that pumpkins have long been used in various cultures due to its extensive variety of qualities, which include anti-diabetic, anti-hypertension, immunomodulation, antibacterial, anti-hypercholesterolemia, anti-tumor, and antioxidant action.

Kelley *et al*. (2013) mentioned that previous research has demonstrated the effectiveness of fruits like apples and cherries, as well as the phytochemical extracts they contain, in lowering the risk factors for metabolic disorders such belly fat deposition, type 2 diabetes, heart disease, and inflammation.

Difonzo *et al*. (2019) stated that the sole fruit in the *Bromeliaceae* family that is edible is a tropical variety called pineapple (*Ananas comosus* L.). Vitamin C, polyphenols, phytochemicals, flavonoids, micronutrients, and minerals are all plentiful in it. Consumers appreciate pineapples for their natural aroma, flavour, and functional qualities in addition to the fact that they are high in bioactive. This distinctive flavour of pineapple is produced by a combination of amino acids, amines, phenolic chemicals, and furanone. **Ali *et al*. (2020)** said that additionally, pineapple has been shown to provide a number of health advantages, such as anti-inflammatory and antioxidant activity, monitoring nervous system activity, and mending bowel movement. **Akbari *et al*. (2022)** reported that antioxidants found in pineapple are known to reduce heart disease and some other chronic conditions connected to oxidative damage.

Hegazi *et al* (2021) said that significant modern pharmacological and clinical evidence has highlighted the wide medicinal applications of pomegranate fruit parts and its juice, which makes it superior to other fruit juices and a fortified source of dietary polyphenols with potential antioxidant efficacy. Pomegranate (*Punica granatum*) is an ancient perennial plant species of the Punicaceae family, known as the "miracle fruit" because its seeds are consumed as food, juice, and/or as a functional food. **Reyes *et al*. (2022)** reported that due to the real discovery of phytochemical substances with antioxidant, anti-inflammatory, and antiviral

activity with use in products of the food sector and pharmaceutical, the collection and consumption of fruit have increased in Mexico. **Sabale *et al.* (2020)** mentioned that pomegranates have great health benefits and nutritional worth. Both fresh and juice versions are enjoyed. Pomegranate exhibits antioxidant, anti-diabetic, antibacterial, anti-inflammatory, antiviral, anticancer, and hypolipidemic effects, according to both in vitro and in vivo research. Pomegranates also aid to boost cardiovascular and oral health. Pomegranates currently have a wealth of nutritional and therapeutic qualities. Pomegranates have the ability to treat and prevent a number of ailments. **Sandoval *et al.* (2022)** mentioned that the fruits high in polyphenols include pomegranates. Studies have demonstrated that pomegranate extracts made from the fruit's juice or other sections of the plant have a range of biological properties, including antioxidant, antibacterial, anti-inflammatory, anti-carcinogenic, cardio-protective, and anti-diabetic properties. Pomegranate juice's physiological effects include a reduction in the harm caused by oxidative stress, an increase in insulin-dependent glucose absorption, maintenance of -cell integrity, prevention of non-enzymatic protein glycation, and an improvement in insulin sensitivity. This study aims to determine the chemical composition, vitamins, minerals, antioxidant activities of barley water extract, flaxseed water extract and juices of fruits (pumpkin, apple, pineapple and pomegranate).

Materials and methods

Materials:

Barley (*Hordeum vulgare*), flaxseeds (*Linum usitatissimum*) and fresh fruits: pumpkin (*Cucurbita moschata*), red apple (*Malus domestica***)**, pineapple (*Ananas comosus*) and pomegranate (*Punica granatum*) were obtained from the local market of Mansoura city, Egypt.

Methods:

Barley and flaxseed aqueous extracts: 100 g of barley was cleaned without peeling, washed with distilled water, boiled for five minutes and left in boiled water (300mL) for the whole night. 100 g of flaxseed was cleaned, washed with distilled water, soaked in boiled water (500 ml) for the whole

night. Barley and Flaxseed aqueous extract was filtered, filled in glass bottles, covered and stored in a deep freezer (-18^{O}C) until used.

Products analytical methods:

Chemical analysis:

- Moisture, protein, fat, total ash and fiber contents were determined according to **AOAC (2000).** Total carbohydrate was calculated as follows

100 – (ash% + moisture %+ fat %+ protein%) according to **Shumaila and Mahpara (2009**).

- **Vitamin C** was determined using Aglient HPLC (uv-vis) as described by **Serrano *et al.* (2007)**
- **Vitamins A and E** were determined using Schmidzua HPLC (PDA) as described by **Gomis *et al.* (2000)**. **Vitamin K** was analyzed using a reversed-phase highperformance liquid chromatography procedure described elsewhere (**Booth and Sadowski, 1997**). **Minerals**: After acid digestion using HNO3 (69%) and HF (40%) in a microwave digestion apparatus (model Milestone MLS 1200 Mega), the concentrations of the sample minerals were assessed using an inductivity coupled plasma apparatus (iCAPTM 7000 Plus Series ICP-OES, Thermo ScientificTM) as mentioned by **Khan *et al*. (2014).**
- **Omega 3 and omega 6:** Gas chromatography (GC) has been used to analyze fatty acids (omega 3 and omega 6) according to **Baokun-Tang (2013). Beta-carotene** was determined in samples according to A**.O.A.C (2005).**

Antioxidant parameters:

- **Determination of total phenols:** 2 g of powdered sample material was extracted with methanol at room temperature. On a rotary evaporator, the methanol extracts were mixed and concentrated under reduced pressure. The total phenolic content of each plant's extract was measured using the Folin-reagent Ciocalteu's (FCR). Each sample (0.5 ml) was combined with and 2.5 ml of FCR (diluted 1:10, v/v) then 2 ml

of Na2CO3 (7.5%, v/v) solution . After 90 minutes of incubation at 30°C, the absorbance was then measured at 765 nm. Results were presented as mg per g of gallic acid of dry extract (**Slinkard and Singleton, 1977**).

- **Determination of total flavonoid:** Every sample was combined with 0.15 ml of a 15% NaNO2 solution after being diluted with 2 ml of distilled water. After waiting for 6 minutes, 0.15 ml of aluminium chloride (AlCl3) solution (10%) was added. The combination was then given another 6 minutes to stand before 2 ml of NaOH solution (4%) was added. Water was immediately added to make the final volume 5 ml. The mixture was then properly stirred and let to stand for an additional 15 minutes. The mixture's absorbance was then measured at 510 nm in comparison to a produced water blank (**Zhishen *et al.*, 1999**).

Statistical analysis:

- SPSS computer software was used to statistically analyze all of the collected data. According to **Abo-Allam (2003),** the computed data were done using an analysis of variance (ANOVA) and a follow-up test (LSD) using SPSS version 11.

Results and discussion

Proximate chemical composition of barley water extract, flaxseed water extract and some fruit juices:

Data presented at Table 1 revealed the chemical composition, represented as moisture, protein, fat, ash, carbohydrates and fiber of barley, flaxseed, pumpkin, apple, pineapple and pomegranate. Results showed that the mean values of barley extract were 60.01 ± 0.11, 4.36 ± 0.05, 1.09 ±0.03, 0.93±0.02, 33.61 ± 0.17 and 9.32 ±0.07 g/100g for moisture, protein, fat, ash, carbohydrates and fiber, respectively. While, flaxseed extract recorded 45.96± 0.12,7.85 ±0.07, 27.16±0.07, 2.95 ±0.04, 16.08 ± 0.02 and 12.63 ±0.04 g/100 for the same previous parameters, respectively.

As for used fruits, results showed that the average content of apple juice was 79.97 ±0.097, 0.43±0.06, 0.37± 0.05, 0.58±0.06, 18.65±0.08 and

4.33 ±0.08, for pineapple was 83.91±0.06, 0.87±0.06, 0.19 ±0.03, 0.38 ± 0.05, 14.65±0.14 and 2.09±0.08 g/100g for moisture, protein, fat, ash, carbohydrate and fiber, respectively. Regards pumpkin, data explained that the average content was 85.94± 0.07, 1.19±0.08, 0.29 ± 0.05, 1.05 ±0.04, 8.53 ± 0.10 and 1.97±0.14 g/100g, respectively. While pomegranate juice recorded 76.04 ± 0.07, 1.96 ±0.04, 1.42±0.07, 0.93 ±0.02, 19.65 ± 0.08 and 4.31 ±0.07 g/100g for the same previous parameters respectively.

From the previous data, the highest moisture content was recorded for pumpkin juice, followed by pineapple juice, apple juice, pomegranate juice and barley extract then flaxseed extract. While the highest protein content was recorded for flaxseed extract, followed by barley extract and then pomegranate juice. Results showed that flaxseed extract recorded the highest protein, fat, ash and fiber contents. While barley extract recorded the highest carbohydrate content.

Regards fruits' juice composition,pomegranate recorded the highest protein, fat and carbohydrates when compared to other fruits. While pumpkin recorded the highest ash content and pineapple juice recorded the highest fiber content comparing to other fruit juices. Results were in the line with **Li *et al.* (2006)** who found that pomegranate plant *Punica granatum L. (Punicaceae*) is one of the most fruit rich in phytochemical compounds i.e polyphenols and ellagic acid (**Miguel *et al.*, 2010**) as well as protein, vitamins carbohydrates, amino acids, fatty acids, and pectin. Also **Ali *et al.* (2016)** mentioned that addition of crude pomegranate juice to the yoghurt drink caused an increase in the ash, fat, protein and total carbohydrate contents while viscosity, pH and the total counts of bacteria decreased. According to **Nagib *et al.* (2005**), pumpkin fruits contain 87.8 % moisture. They are considered one of the important sources of carotenoids (Pro. Vitamin A), ascorbic acid, fibers and minerals (**Woodall *et al,* 1997 and Lingle *et al,* 1993**). **Sabahelkhier *et al.* (2010)** indicated that pineapple contains considerable amount of calcium, potassium, vitamin C, carbohydrates, crude fibre, water and different minerals that is good for the digestive system and helps in maintaining ideal weight and balanced nutrition.

Table (1): Proximate chemical composition of barley water extract, flaxseed water extract and fruit juices:

Samples	Moisture	C. protien	T. fat	Ash	T. carbohydrates	D. Fiber
g/100g						
Barley water extract	60.01^{e} ±0.11	4.36^{b} ±0.05	1.09^{c} ±0.03	0.93^{c} ±0.02	33.61^{a} ±0.17	9.32^{b} ±0.07
Flaxseed water extract	45.96^{f} ±0.12	7.85^{a} ±0.07	27.16^{a} ±0.07	2.95^{a} ±0.04	16.08 ^{d}±0.02	12.63^{a} ±0.04
Pumpkin juice	88.94^{a} ±0.07	1.19^{d} ±0.08	0.29^{d} ±0.05	1.05^{b} ±0.04	8.53^{f} ±0.10	1.97^{d} ±0.14
Apple juice	79.97^{c} ±0.09	0.43^{f} ±0.06	0.37^{d} ±0.05	0.58^{d} ±0.06	18.65^{c} ±0.08	4.33^{c} ±0.08
pineapple juice	83.91^{b} ±0.06	0.87^{e} ±0.06	0.19^{e} ±0.03	0.38^{e} ±0.05	14.65^{e} ±0.14	2.09^{d} ±0.08
Pomegranate juice	76.04^{d} ±0.07	1.96^{c} ±0.04	1.42^{b} ±0.07	0.93^{c} ±0.02	19.65^{b} ±0.08	4.31^{c} ±0.07
LSD at 0.05	**0.16**	**0.11**	**0.09**	**0.07**	**0.19**	**0.15**

a,b,c,d= Different superscripts Within the same column represent significant differences between the results ($p<0.05$); LSD= Least significant differences n.s= non-significant and ± = Means standard deviation.

Vitamins content of barley water extract, flaxseed water extract and fruit juices:

Vitamins content included (V.A, V.C, V.E and V. K) in barley extract, flaxseed extract and fruit juices (pumpkin, apple, pineapple and pomegranate) were represented in Table 2. Barley extract recorded 23.50 ±0.33 IU, 0.95± 0.04, 0.09 ±0.04 mg/100g and 2.27 ±0.05 mg/100g for V.A, V.C, V.E and V.K, respectively. While flaxseed extract recorded 0.85±0.03, 0.41 ± 0.07 and 4.74±0.03 for V.C, V.E and V.K, respectively. Results show that pumpkin juice recorded the highest content of V.A (8153.00 ± 0.65 IU) and vitamin E (1.29 ±0.06 mg/100g). While the highest V.C content was

recorded for pineapple (49.30 ±0.12 mg/100g) and the highest V.K content recorded in pomegranate juice.

Results are in the same trend of ***Siwela et al.* (2022)** who found that feeding less than 50 g of cooked pumpkin per day meets 100% of the recommended dietary allowance (RDA) and adequate intake (AI) of vitamin A for children 6 to 24 months old. Consumption of pumpkin may be used to complement vitamin A supplementation, fortification, and diversification of CFs with animal source foods. However, it is reported that pineapples have many nutritional benefits providing several essential mineral, vitamins (B1, B2, C) and fibre **(USDA, 2005)**. **Zheng and Lu *(2011)*** observed that pineapple juice contributes to healthy living because it is a good source of vitamins, phenols, organic acids and carbohydrate. **Hossain (2015)** stated that pineapple is one of the most important tropical fruit. It is a rich source of vitamin C, vitamin A, vitamin B1, vitamin B2 and minerals like calcium, phosphorus, and iron. According to **USDA (2010)**, pomegranate has been reported to be rich source of vitamins like foliate and vitamin K.

Table (2): Vitamins' content of barley water extract, flaxseed water extract and fruit juices:

Samples	V.A IU	V.C mg/100g	V.E mcg/100g	V.K mcg/100g
Barley water extract	23.50^{d}±0.33	0.95^{e}±0.04	0.09^{e}±0.04	2.27^{d}±0.05
Flaxseed water extract	0.00^{f}±0.00	0.85^{e}±0.03	0.41^{c}±0.07	4.74^{b}±0.03
Pumpkin juice	8153.00^{a}±0.65	11.32^{c}±0.07	1.29^{a}±0.06	1.43^{e}±0.06
Apple juice	65.90^{b}±0.45	5.82^{d}±0.08	0.29^{d}±0.06	2.86^{c}±0.06
pineapple juice	58.70^{c}±0.50	49.30^{a}±0.12	0.18^{e}±0.04	0.93^{f}±0.06
Pomegranate juice	2.60^{e}±0.15	11.72^{d}±0.12	1.09^{b}±0.05	18.04^{a}±0.07
LSD at 0.05	**0.73**	**0.15**	**0.10**	**0.10**

V.A: Retinol V.C: Ascorbic acid V.E: Tocopherol a,b,c,d= Different superscripts Within the same column represent significant differences between the results ($p<0.05$); LSD= Least significant differences n.s= non-significant and ± = Means standard deviation.

Mineral contents of barley water extract, flaxseed water extract and fruit juices:

Mineral contents included calcium (Ca), magnesium (Mg), potassium (K), phosphor (P), iron (Fe), zinc (Zn), manganese (Mn), mg/100g and selenium (Se) mcg /100g for barley extract, flaxseed extract and fruit juices (pumpkin, apple, pineapple and pomegranate) are shown in Table 3 . Results show that the mean value of minerals' content in barley extract were (32.60 ±0.29) Ca, (80.40 ±0.30) Mg, (281.60 ±0.75) K, (123,30 ±0.66) P, (2.57 ±0.06) Fe, (23.40 ±0.05) Zn, (1.41 ±0.05) mg/100g and content and (38.60 ±0.11) mcg/100g Se. While flaxseed extract recorded (261.50 ±0.4, 398.40 ±0.50, 837.80 ±0.82, 641.70 ±0.42, 5.69 ±0.07, 4.56 ±0.05 and 3.65 ±0.04) mg/100g and 26.80±0.09 mcg/100g for Ca, Mg, K, P, Fe, Zn, Mn and Se, respectively.

Regards mineral contents of used fruit juices, data show that pumpkin juice recorded (27. 82 +0.71, 14.25±0.11, 416.50± 1.05, 53.95 ± 28, 1.16±0.06, 0.53±0.05 and 0.18 ±0.04) mg/100g and 0.39 ±0.07 mcg/100g for Ca, Mg, K, P, Fe, Zn, Mn and Se, respectively. While mineral contents of apple juice recorded (7.92 ±0. 38, 6.35±0.54, 138.50± 0.6, 14.90±0.70, 0.24±0.06, 0.07 ± 0.03, 0.19 ± 0.04) g/100g and 0.29 ±0.06 mcg/100g. As for pineapple and pomegranate juices, data presented in the same table show that mineral contents of pineapple juice recorded (13.90±0.31, 12.40±0.45, 112.50 ±0.6, 8.93 ± 0.37, 0.41 ± 0.05, 0.19 ±0.06, 0.78 ± 0.04) mg/100g and 0.17 ±0. 06 mcg/100g for Ca, Mg, K, P, Fe, Zn, Mn and Se respectively. Meanwhile pomegranate juice mineral content recorded (11.80 ±0.56, 14.60 ± 0.38, 268. 40 ±0.45, 43.60 ±1.19, 0.41 ± 0.04, 0.53±0.06, 0.19 ±0.07) mg/100g and 0.93±0.04 mcg/100g for the previous minerals, respectively.

From the previous results, flaxseed extract is rich in Ca, Mg, K, P, Fe and Mn, while barley extract is rich in Zn and Se. Meanwhile regards fruits juices, pumpkin juice scored the highest Ca, K, P, Fe and Zn comparing to other fruit juices. While pineapple juice scored the highest Mn content but the highest Se score recorded in pomegranate juice. As for Mg and Zn, pumpkin and pomegranate recorded the highest scores comparing to other fruit juices. The obtained results were in accordance with **Lahouar *et***

***al*. (2015)** who mentioned that young green barley powder consist of significant quantities of Zn, Fe, Ca, Mg, K, Beta-carotene, folic acid, chlorophyll, vitamin C, vitamin B12 and pantothenic acid. On another hand**,** according to its physico-chemical composition, flaxseed is a multicomponent system with bio-active plant substances such as oil, protein, dietary fiber, soluble polysaccharides, lignans, phenolic compounds, vitamins (A, C, F and E) and mineral (P, Mg, K, Na, Fe, Cu, Mn and Zn) (**Bhatty, 1993). Ravi *et al.* (2010)** stated that pumpkin pulp has rich source of vitamins and mineral salts for human consumption. Also according to **Espinosa *et al. (*2006)**, pineapple found to be the fruit that contains the highest concentration of manganese when compared with other fruits analyzed in vitro.

Table (3): Mineral contents of barley water extract, flaxseed water extract and fruit juices:

Samples	Ca	Mg	K	P	Fe	Zn	Mn	Se
	mg/100g							mcg/100g
Barley water extract	32.60^{b} ±0.29	80.40^{b} ±0.30	281.60^{c} ±0.75	223.30^{b} ±0.66	2.57^{b} ±0.06	23.40^{a} ±0.05	1.41^{b} ±0.05	38.60^{a} ±0.11
Flaxseed water extract	261.50^{a} ±0.47	398.40^{a} ±0.50	837.80^{a} ±0.82	641.70^{a} ±0.42	5.69^{a} ±0.07	4.56^{b} ±0.05	3.65^{a} ±0.04	26.80^{b} ±0.09
Pumpkin juice	27.82^{c} ±0.71	14.25^{c} ±0.11	416.50^{b} ±1.05	53.95^{c} ±0.28	1.16^{c} ±0.06	0.53^{c} ±0.05	0.18^{d} ±0.04	0.39^{d} ±0.07
Apple juice	7.92^{f} ±0.38	6.35^{e} ±0.54	138.50^{e} ±0.62	14.90^{e} ±0.70	0.24^{e} ±0.06	0.07^{e} ±0.03	0.19^{d} ±0.04	0.29^{de} ±0.06
pineapple juice	13.90^{d} ±0.31	12.40^{d} ±0.45	112.50^{f} ±0.65	8.93^{f} ±0.37	0.41^{d} ±0.05	0.19^{d} ±0.06	0.78^{c} ±0.04	0.17^{e} ±0.06
Pomegranate juice	11.80^{e} ±0.56	14.60^{c} ±0.38	268.40^{d} ±0.45	43.60^{d} ±1.19	0.41^{d} ±0.04	0.53^{c} ±0.06	0.19^{d} ±0.07	0.93^{c} ±0.04
LSD at 0.05	**0.84**	**0.72**	**1.33**	**1.20**	**0.10**	**0.09**	**0.09**	**0.13**

Ca: Calcium, Mg: Magnesium , K: Potassium, P: Phosphor, Fe: Iron, Zn: Zinc, Mn: Manganese and Se: Selenium

a,b,c,d= Different superscripts Within the same column represent significant differences between the results ($p<0.05$); LSD= Least significant differences n.s= non-significant and ± = Means standard deviation.

Bio-active compound of of barley water extract, flaxseed water extract and fruit juices:

Bio active compound for all samples (represented as omega 3 - omega 6 - Beta-carotene - T.Phenol – T.flavonoid mg/100g) for barley extract, flaxseed extract, fruit juices (pumpkin, apple, pineapple and pomegranate) are shown in Table 4. Significant differences were observed between all samples in omega 3 and omega 6 content. Results revealed that flaxseed recorded the highest omega 3 and omega 6 content (10530.00±0.60 and 2918.00±0.060 mg / 100g), followed by barely extract (108.50±0.15 and 993.70 ±0.50 mg/100g for omega 3 and omega 6, respectively). As for beta-carotene, results show that pumpkin juice recorded the highest beta-carotene content (13.85 ±0.06 mg/100g) followed by apple juice (57.82 ± 0.42 mg/100g). While the highest total phenols was recorded in flaxseed extract (996.50 ±0.66 mg/l00g), followed by pumpkin juice (501.90 ±0.50 mg/l00g), then barley extract (491. 30 ±120 mg/100g). Regards total flavonoid, the highest content recorded 518.60 ±0. 65 mg/100g in apple juice followed by 371. 60±0.94 mg/100g in pumpkin juice, then 226.50±1.04 mg/100g in pomegranate juice, while barley extract recorded 117.80±0.65 mg/100g for flavonoid content.

Data also show that flaxseed extract is the richest in omega 3, omega 6 and total phenols, also barley recorded high content in omega 3 and omega 6. As for fruit juices components, pineapple juice recorded the highest omega 3 content, followed by apple and pomegranate juices. While pomegranate recorded the highest omega 6 content, the highest total flavonoid content was recorded for apple juice. Pumpkin juice was noticed to be the richest in beta-carotene and total phenol when compared to other fruit juices. The obtained results are in agreement with those of **İşleroğlu *et al*. (2005)** who observed that flaxseed is one of the richest omega-3 sources, and it is also rich in soluble and insoluble fiber, lignan, protein and antioxidant components. Also ***Yawale*** **(2022)** mentioned that flaxseed or linseed is an oilseed obtained from a herb known as flax plant. It is a valuable source of various bio-active components such as omega-3 polyunsaturated fatty acids, protein, lignan, dietary fiber and

phytochemicals. Meanwhile, **Hussain *et al.* (2022)** reported that pumpkins are natural and rich source of potential bioactive compounds. The presence of active phytochemicals makes these fruits a great matrix to be further exploited for therapeutic purposes, beyond biotechnological applications. Peel, flesh and seeds of this fruit are heavily loaded with phenolic, flavonoids and carotenoids, which are the main tributes of this functional and medicinal food. **Jun *et al.* (2006)** reported high amounts of pectin, mineral salts, carotene, vitamins, and other substances beneficial to human health in pumpkin. On the other hand, **Der Sluis *et al.* (2002)** stated that apples are an important source of flavonoids in the human diet.

Table (4): Bio-active compound of barley water extract, flaxseed water extract and fruit juices:

Samples	Omega 3	Omega 6	B.carotien	T.phenol	T.flavonoid
	mg/100g				
Barley water extract	108.50^{b} ±0.15	993.70^{b} ±0.50	2.49^{d} ±0.08	491.30^{c} ±1.20	117.80^{d} ±0.65
Flaxseed water extract	10530.00^{a} ±0.60	2918.00^{a} ±0.60	0.93^{f} ±0.04	996.50^{a} ±0.666	71.60^{e} ±1.05
Pumpkin juice	3.77^{e} ±0.12	2.85^{f} ±0.40	13.85^{a} ±0.06	501.90^{b} ±0.50	371.60^{b} ±0.94
Apple juice	12.65^{d} ±0.22	57.82^{d} ±0.42	3.66^{b} ±0.07	221.40^{e} ±0.86	518.60^{a} ±0.65
pineapple juice	17.80^{c} ±0.26	23.90^{e} ±0.20	2.98^{c} ±0.04	60.80^{f} ±0.74	45.80^{f} ±0.15
Pomegranate juice	12.50^{d} ±0.24	227.40^{c} ±0.25	1.72^{e} ±0.06	239.80^{d} ±1.02	226.50^{c} ±1.04
LSD at 0.05	**0.55**	**0.74**	**0.11**	**1.53**	**1.44**

a,b,c,d= Different superscripts Within the same column represent significant differences between the results ($p<0.05$); LSD= Least significant differences n.s= non-significant and ± = Means standard deviation.

Conclusion

Nutritional science in the future will be heavily influenced by using some functional cereals' extracts and fruit juices such as flaxseeds, barley, pomegranate, pineapple, apple and pumpkin. We will be able to sustain health, by using these prepared drinks rich in nutritional value and antioxidants that is referred to positively affect general health.

References

- **A.O.A.C. (2000):** Official methods of analysis Association of Official Analytical Chemists. 13th Ed. Published Chemists, Washington D.C, U.S.A.
- **A.O.A.C. (2005):** Official methods of analysis Association of Official Analytical Chemists. 18th Ed. Published Chemists, Washington D.C, U.S.A.
- **Abo-Allam, R M (2003):** *Data statistical analysis using SPSS program*. 1st,ed., publication for Universities, Cairo.
- **Akbari, B; Yazdi, N B; Bahmaie, M and Abhari, F M (2022):** The role of plant-derived natural antioxidants in reduction of oxidative stress. *Biofactors*, 48 (3): 611-633.
- **Ali, H M (2016):** Influence of Pomegranate Punica granatum as Phytochemical Rich Components on Yoghurt Drink Characteristics. Middle East Journal of Applied Sciences, 6(1):23-26.
- **Ali, M M; Hashim, N; Abd Aziz, S and Lasekan, O (2020):** Pineapple (*Ananas comosus*): A comprehensive review of nutritional values, volatile compounds, health benefits, and potential food products. *Food Research International*, 137.
- **Attarde, D L; Kadu, S S; Chaudhari, B J; Kale, S S and Bhamber, R. S (2010):** In vitro antioxidant activity of pericarp of *Cucurbita maxima Duch*. ex Lam. *International Journal of PharmTech Research*, 2 (2):1533– 1538.
- **Baokun-Tang K H ,R (2013):** Development of Gas Chromatography Analysis of Fatty Acids in Marine Organisms. *J. Chromatogr*. Sci. ;51:599–607.
- **Bemfeito, C M; Carneiro, J; de, D S; Carvalho, E E N; Coli, P C; Pereira, R C and Boas, E V D B V (2020):** Nutritional and functional potential of pumpkin (*cucurbita moschata*) pulp and pequi (*caryocar brasiliense camb*). peel flours. *Journal of Food Science and Technology*, 57 (10): 3920-3925.

- **Bhatty, R S (1993):** Further compositional analyses of flax: mucilage, trypsin inhibitors and hydrocyanic acid. *Journal of the American Oil Chemists Society*, 70:899-904.
- **Booth, S L; Sadowski, J A (1997):** Determination of phylloquinone in foods by high-performance liquid chromatography. *Methods Enzymol*.;282:446- 456.
- **Ceclu, L; Mocannu, D and Nistor, O (2020):** Pumpkin – health benefits. *Journal of Agroalimentary Processes and Technologies,* 26 (3): 241-246.
- **Collar, C and Angioloni, A (2014):** Nutritional and functional performance of high B-glucan barley flours in breadmaking: mixed breads versus wheat breads. *Eur. Food Res. Technol.,* 238 (3): 459-469.
- **Das, R; Biswas, S and Banerjee, E. R. (2016):** Nutraceutical-prophylactic and therapeutic role of functional food in health. *Journal of Nutrition & Food Sciences,* 6 (527), 2. 10.4172/2155-9600.1000527
- **Der Sluis, A A V; Dekker, M; Skrede, G and Jongen W M F (2002):** Activity and Concentration of Polyphenolic Antioxidants in Apple Juice. 1. Effect of Existing Production Methods. *J. Agric. Food Chem*, 7211–7219.
- **Difonzo, G; Vollmer, K; Caponio, F; Pasqualone, A; Carle, R and Steingass, C B (2019):** Characterisation and classification of pineapple (*Ananas comosus* L.] Merr.) juice from pulp and peel. *Food Control*,96: 260-270.
- **Espinosa, M G; Sosa, M; De Leon-Rodriguez, L M et al. (2006)** Blackberry (*Rubus spp*.): a pH-dependent oral contrast medium for gastrointestinal tract images by magnetic resonance imaging. *Magn Reson Imaging,* 24(2):195–200**.**
- **Gomis, D B; Fernández, M P and Alvarez, M D G (2000):** Simultaneous determination of fat-soluble vitamins and provitamins in milk by microcolumn liquid chromatography. *Journal of Chromatography A*, 891(1):109-14.
- **Guo, T; Horvath, C; Chen, L; Chen, J and Zheng, B (2020):** Understanding the nutrient composition and nutritional functions of highland barley (Qingke): A review. *Trends in Food Science & Technology*, 103, 109–117. 10.1016/j.tifs.2020.07.011
- **Hegazi, N M; El-Shamy, S; Fahmy, H and Farag, M A (2021):** Pomegranate juice as a super-food: A comprehensive review of its extraction, analysis, and quality assessment approaches. *Journal of Food Composition and Analysis*, 97.

- **Hossain, F Md. (2015):** Nutritional value and medicinal benefits of pineapple. *International Journal of Nutrition and Food Sciences,* 4(1):8
- **Hussain, A; Kausar, T; Sehar,S; Sarwar, A; Ashraf, A H; Jamil, M G; Noreen, S; Rafique, A; Iftikhar, K; Quddoos , M Y; Aslam, J and Majeed, M A (2022):** A Comprehensive review of functional ingredients, especially bioactive compounds present in pumpkin peel, flesh and seeds, and their health benefits. *Food Chemistry Advances,* 1.
- **Idehen, E; Wang, W and Sang, S (2020):** Health benefits of barley for diabetes. *Journal Of Food Bioactives,* 12.
- **İşleroğlu, H; Yıldırım, Z and Yıldırım, M (2005):** Flaxseed as a functional food. *Journal of Agricultural,* 22(2): 23-30.
- **Jun, H I; Lee, C H; Song, G S and Kim, Y S (2006):** Characterization of the pectic polysaccharides from pumpkin peel. *LWT-Food Science and Technology,* 39(5): 554–561.
- **Kelley, D S; Adkins, Y; Reddy, A; Woodhouse, L R; Mackey, B E and Erickson, K L (2013):** Sweet bing cherries lower circulating concentration of markers for chronic inflammatory disease in healthy humans. *J Nutr.,* 143 (3): 340-344.
- **Lahouar, L; El-Bok, S and Achour, L (2015):** Therapeutic potential of young green barley leaves in prevention and treatment of chronic diseases: an overview. *Ame. J. Chinese Med.,* 43 (7): 1311-1329.
- **Li, Y; Guo, C; Yang, J; Wei, J; Xu, J and Cheng, S (2006):** Evaluation of antioxidant properties of pomegranate peel extract in comparison with pomegranate pulp extract. *Food Chem.,* 96 : 254-260.
- **Lingle, S;E, Melons, Squashes and Gourds (1993).**In encyclopedia of food Science Food Technology and Nutrition, vol.5 (R.McCrae. R.K. Robinson and M.J. Sandlers. eds) Academic Press New York, P.2960
- **Miguel, M G; Neves, M A and Antunes, M D (2010):** Pomegranate (*Punica granatum L.*): a medicinal plant with myriad biological properties—a short review. *J. Med. Plant Res.,* 4 2836-2847.
- **Khan, N; Choi, J Y and Nho, E Y (2014):** Determination of minor and trace elements in aromatic spices by micro-wave assisted digestion and inductively coupled plasma-mass spectrometry. *Food Chemistry*, 158 (01):200-206.

- **Nagib, A I (2005):** Preparation of dried blends from papaya. Mango and pumpkin fruits. J. Agric. Sci. mansoura univ;30(8): 4637.
- **Serrano, O I; Jover, H T and Belloso, M O (2007):** Comparative study of UV-HPLC methods and reducing agents to determine vitamin C in fruits. *Food Chemistry*; 105(3):1151-1158.
- **Ravi, U; Menon, L; Aruna, M and Jananni, B.K (2010):** Development of Orange-White Pumpkin Crush and Analysis of its Physicochemical, Nutritional and Sensory Properties. *American-Eurasian J. Agric. & Environ. Sci.,* 8 (1): 44-49.
- **Reyes, J A C; Penagos, C J C and Hernandez, J C G (2022):** Chemical composition and great applications to the fruit of the pomegranate (*Punica granatum*): a review. *Food Science and Technology*, 42.
- **Sabahelkhier, K M; Hussain, A S and Ishag, K E A (2010):** Effect of maturity stage on protein fractionation, in vitro protein digestibility and anti-nutrition factors in pineapple (*Ananas comosus*) fruit grown in Southern Sudan. *Afr. J. Food Sci*, 4 (8):550 -552.
- **Sabale, S; Rao, P and Jadhav, R (2020):** Nutritional Value Of Pomegranate: A REVIEW. *World Journal of Pharmaceutical Research,* 9 (5): 733-744.
- **Saka, I; Baumgartner, B and Özkaya, B (2022):** Usability of microfluidized flaxseed as a functional additive in bread. *J. Sci. Food Agric*, 102: 505–513.
- **Sandoval, C O; Illescas, H E F; Martínez, E F; Rodríguez, M A O; Cortés, R C; Ortega, J A A; González, J C H; Olivo, D; Vega, C V; Miller, H B and Cabrera, G B (2022):** Potential Mechanisms of the Improvement of Glucose Homeostasis in Type 2 Diabetes by Pomegranate Juice. Antioxidants, 11(3).
- **Shaikh, R P; Gadhe, K S and Syed S J (2020):** Studies on physico-chemical and functional properties of flaxseed flour. *Journal of Pharmacognosy and Phytochemistry,* 9 (1): 2309-2312.
- **Sharma, P; Kaur, G; Kehinde, B A; Chhikara, N; Panghal, A and Kaur, H (2020):** Pharmacological and biomedical uses of extracts of pumpkin and its relatives and applications in the food industry: a review. *International Journal of Vegetable Science*, 26 (1): 79-95.
- **Shumaila, G. and Mahpara, S. (2009**): Proximate Composition and Mineral Analysis of Cinnamon. *Pakistan Journal of Nutrition*; 8(9): 1456-1460.

- **Siwela, M Edward Buzigi, E and Pillay, K (2022):** Potential of pumpkin to combat vitamin A deficiency during complementary feeding in low and middle income countries: variety, provitamin A carotenoid content and retention, and dietary reference intakes. *Critical Reviews in Food Science and Nutrition*, 62 (22): 6103-6112.
- **Slinkard, J. and Singleton, V. L.** (1977): Total phenol analysis: automation and comparison with manual methods. *Am. J. Enol. Viticult*; 28: 49–55.
- **Tang, Z X; Shi, L E; Wang, X M; Dai, G W; Cheng, L A; Wan, Z X; He, H; Wu, Q; Wang, Y B; Jin, X Y; Ying, R F and Huang, L H (2020):** Whole Flaxseed-based Products and Their Health Benefits. *Food Science and Technology Research*, 26: 561-578.
- **Treanore, E D; Vaudo, A D; Grozinger, C M and Fleischer, S J (2019):** Examining the nutritional value and effects of different floral resources in pumpkin agroecosystems on Bombus impatiens worker physiology. *Apidologie*, 50 (4): 542-552.
- **USDA (2005):** Department of Health and Human Services. *Dietary Guidelines for Americans*.
- **USDA (2010)**: World Agriculture Production. USDA, *Foreign Agriculture Service*, Circular service. WAP 05-10.
- **Waston, R R and Preedy, V R (2019):** Bioactive Food as Dietary Interventions for Diabetes. *Bioactive Foods in Chronic Disease States*, 361-374.
- **Woodall, AA; Britton, G and Jackson, M J (1997):** Carotenoids and protection of phospholipids in solution or in liposomes against oxidation by peroxyl radicals : Relationship between carotenoids structure and protective ability. Biochim. Biophys. Acta 1336: 585-586
- **Yadav, M; Jain, S; Tomar, R; Prasad, G B K S and Yadav, H (2010):** Medicinal and biological potential of pumpkin: an updated review. *Nutrition Research Reviews*, 23: 184-190.
- **Yawale, P (2022):** A Comprehensive Review On Recent Novel Food And Industrial Applications Of Flaxseed: 2014 Onwards. *Food and Feed Research*, 49 (1)**.**
- **Zheng, H and Lu, H (2011):** Use of kinetic, Weibull and PLSR models to predict the retention of ascorbic acid, total phenols, and antioxidant activity

during storage of pasteurized pineapple juice. LWT-Food Science and Technology, 44 (5): 1273-1281**.**

- **Zhishen, J.; Mengcheng, T. and Jianming, W. (1999):** The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. *Food Chem*., 64: 555–559.
- **Zhu, L; Sha,L; Li, K; Wang, Z; Wang, T; Li, Y; Liu, P; Dong, X; Dong, Y; Zhang, X and Wang, H (2020):** Dietary flaxseed oil rich in omega-3 suppresses severity of type 2 diabetes mellitus via anti-inflammation and modulating gut microbiota in rats. *Lipids in Health and Disease*, 19.

الخصائص الغذائية لبعض مستخلصات الحبوب وعصائر الفواكه الوظيفية

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الملخص العربي:

هدفت الدراسة الحالية إلى تقدير المحتوى الكيميائي شاملا الفيتامينات والمعادن والأنشطة المضادة للأكسدة لمستخلص الشعير ومستخلص بذور الكتان وثمار اليقطين والتفاح والأناناس والرمان. وقد أظهرت النتائج أن مستخلص بذور الكتان سجل أعلى محتوى من البروتين والدهون والرماد والألياف، في حين سجل مستخلص الشعير أعلى محتوى من الكربوهيدرات. وبين الفاكهة، سجل الرمان أعلى نسبة من البروتين والدهون والكربوهيدرات، في حين سجل اليقطين أعلى محتوى من الرماد وسجل عصير الأناناس أغنى محتوى من الألياف مقارنة مع عصائر الفاكهة الأخرى. وأظهرت النتائج أن عصير اليقطين سجل أعلى محتوى من V.A وفيتامين E، في حين تم تسجيل أكبر محتوى من V.C في الأناناس وأكبر محتوى من V.K في عصير الرمان. كما أشارت النتائج إلى غنى مستخلص بذور الكتان من الكالسيوم والمغنيسيوم والبوتاسيوم والفوسفور والحديد والمنغنيز، وغنى مستخلص الشعير بالزنك والسيلينيوم. كما سجل عصير اليقطين المحتوى الأعلى من الكالسيوم، والبوتاسيوم، والحديد، والزنك مقارنة بعصائر الفاكهة الأخرى. بينما سجل عصير الأناناس أعلى محتوى من المنغنيز، وسجل عصير الرمان أكبر محتوى من السيلينيوم. أما بالنسبة للمغنيسيوم والزنك، فقد سجل اليقطين والرمان أعلى محتوى مقارنة بعصائر الفاكهة الأخرى. وكان مستخلص بذور الكتان هو الأغنى بالأوميجا ٣ والأوميجا ٦ والفينولات الكلية، كما سجل الشعير نسب عالية من الأوميجا ٣ وأوميجا ٦. ومن بين الفواكه، سجل عصير الأناناس أعلى محتوى من الأوميجا ٣ يليه عصائر التفاح والرمان. بينما سجل الرمان أعلى محتوى من أوميجا ٦، وأكبر محتوى إجمالي من الفلافونويد سجل لعصير التفاح. وكان عصير اليقطين هو الأغنى بالبيتا كاروتين والفينول الكلي بالمقارنة مع عصائر الفاكهة الأخرى.

الكلمات المفتاحية: مستخلص الشعير، مستخلص بذور الكتان، اليقطين، التفاح، الأناناس، الرمان

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