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PRODUCTION AND EVALUATION OF HEALTHY SNACKS FROM SOME SEED, GRAIN AND HERBS CULTIVATED IN EGYPT

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ABSTRACT

Extrusion snack was made from yellow corn grits and its blends had contained corn grits, barley, chickpea, cumin, black cumin, black pepper and watercress seeds at different levels to give control and six groups (3 blends for each) to give nineteen blends considerable as watercress seeds of ingredient and products were defined as chemical, constituents, physical properties and sensory evaluation. The results showed that the chickpea had contained the highest in protein content and total lipids 40.60 and 19.50%. The black pepper, chickpea and cumin seeds had contained higher in crude fiber (14.20, 10.71 and 10.50, respectively). The extrusion snack blends made from watercress seeds showed that the protein content was the highest in group No., (2) (blend No., 4, 5 and 6) was amounted 14.93, 16.33 and 17.73 %. Total lipids, crude fiber and ash content were decreased gradually in the extrusion snack blends from group (6) 3.00, 3.12 and 3.01% and the highest in total lipids in group No., 2 which contained 4.23,4.86 and 5.71%, respectively. Hunter color values of snacks control and its extruded different blends made from watercress seeds the group no. (6) (blend No., 16, 17 and 18) prepared with 60% corn grits and 15, 10 and 5% barley and also 6% watercress seeds showed that higher in lightness (L value) and yellowness (b value) till 15% chickpea and nearly control snacks. Moreover, the highest water absorption index (WAI) and water soluble index (WSI) were in groups No., (1 and 2) (blends from No., 1 to 6, respectively) made from 40% corn grits and 40, 35, 30 and 25% barley. The sensory properties the results showed that the extrusion blend No., 18 made from 20% chickpea and 5% barley the highest acceptability (93%) and nearly or equal control (96%) followed by 10 and 15% chickpea plus 15 and 10% barley were gave 89.0 and 91.0% during overall acceptability. The resultant from texture analysis profile were ensure the obviously results.

INTRODUCTION

Food extruders provide thermo-mechanical and mechanical energy (shear) necessary to cause physicochemical changes of raw materials with an intense mixing for dispersion and homogenization of ingredients including conveying, mixing, shearing, heating or cooling, shaping, venting volatiles and moisture, flavor generation, encapsulation, and sterilization (Wiedman and Strobel, 1987). Advantages of this process is that one extruder can operate at relatively low temperatures and produce pasta and baking goods, or at very high temperatures, and then manufacture products with low bulk density, such as snacks and ready to eat cereals (Harper, 1981). In order to make products that will be acceptable in a very competitive market, extrusion of snack foods demands the control of many parameters that will directly or indirectly influence the consumer acceptability. Finished product characteristics are partly resulted from specific critical parameters induced in raw materials. The critical parameters that will partly affect the moisture, expansion, solubility, absorption, color, flavor and texture of the final product are (Huber, 2001):

The chemistry of natural products interacts with different areas of expertise, and its relevance is linked to this interdisciplinary. Chemical studies of different plant species seed to detect information inherent to secondary metabolites and to contribute to the development of several areas of science. The use of plants by humans dates back thousands of years and relies on chance discoveries that are frequently proven by science. They were used to cure diseases, for food preservation and insect control. Many natural compounds present in plants, herbs and spices have shown biological activity and serve as a source of antimicrobial agents against various pathogens Simões *et al*. (2007).

The taste of a spice such as sweet, spicy, sour, or salty, is due to many different chemical components such as esters, phenols, acids, alcohols, chlorides, alkaloids, or sugars. Sweetness is due to esters and sugars; sourness to organic acids (citric, malic, acetic, or lactic); saltiness to cations, chlorides, and citrates; astringency to phenols and tannins; bitterness to alkaloids (caffeine and glycosides); and pungency to the acid-amides, carbonyls, thiocyanates, and isothiocyanates (Raghavan, 2007).

Theoretically, product darkening (developing a brown color) occurs due to the reducing sugars (e.g. liquid honey or glucose syrup) or an increase in the amount of reducing sugars available to participate in the Maillard reaction (Yilmaz and Toledo, 2005). The shelf life of intermediate moisture foods is often limited by Maillard reactions between the carbonyl groups of reducing carbohydrates and the exterior amine groups of proteins. Maillard reactions can lead to an unappealing texture, flavor, nutritional value and color of food products (Loveday *et al*., 2010).

The water absorption index (WAI) measures the volume occupied by the starch after swelling in excess water, and indicates the integrity of starch in aqueous dispersion. Water solubility index (WSI), often used as an indicator of degradation of molecular components, measures the degree of starch conversion during extrusion which is the amount of soluble polysaccharide released from the starch component after extrusion (Yang, 2008). Spices have a definite role to play in enhancing the taste and flavor of any food. A part from this, spices are believed to have medicinal value. They form an important part of the Ayurvedic Pharmacopoeia (Indian System of Medicine). They have been used in a large number of medicinal preparations for the treatment of several disorders, particularly of the digestive system (Sreenivasamurthy and Krishnamurthy, 1959). Cumin seeds are used as a spice for their special aromatic effect, commonly in cuisines of India, Pakistan, North Africa, Middle East, Sri Lanka, Cuba, Northern Mexico and the Western China. Cumin seeds have been reportedly used for traditional treatment of toothache, dyspepsia, diarrhea, epilepsy and jaundice (Nostro *et al*., 2005). The present study aims to evaluation of new blends from seed, grain and herbs to produce healthy snacks and study of impact of blends on chemical composite, physical and organoleptic properties

MATERIALS AND METHODS

Materials:

Hull-less barley seeds (*Hordeum vulgare* L.) cultivar Giza 130, commercial chickpea seeds (*Glycine max)* and yellow corn (*Zea mays* L) were obtained from Field Crops Res. Inst., Agric. Res. Center, Giza-Egypt. Whereas, commercial cumin (*Cuminum cyminum* L.), black cumin (*Nigella* sativa), black pepper (*Piper nigrum* L.) and watercress (*Eruca sativa*) were obtained from Horticulture Res. Inst., Agric. Res. Center, Giza-Egypt. Yellow corn, barley, chickpea, cumin, black cumin, black pepper and watercress seeds were milled in a Laboratory Mill Junior to a fine powder.

Methods:

Protein, total lipids, crude fiber, ash content were determined using standard methods , while total carbohydrates were estimated by differences AOAC. (2005).

Preparation of the snack blends:

Control extruded puff snack was made from yellow corn grits and its blends had contained corn grits, barley, chickpea, cumin, black cumin, black pepper and watercress at different levels to give control and six groups (3 blends for each) to give nineteen blends considerable as watercress seeds (Table 1).

Table (1): Formulae of snack blends :

Group	No Blends	Corn	Barley	Chickpea	watercress	Cumin	Black pepper	Black cumin
Control		100	-	-	-	-	-	-
1	1	40	40	10	4	2	2	2
	2	40	35	15	4	2	2	2
	3	40	30	20	4	2	2	2
2	4	40	35	10	6	3	3	3
	5	40	30	15	6	3	3	3
	6	40	25	20	6	3	3	3
3	7	50	30	10	4	2	2	2
	8	50	25	15	4	2	2	2
	9	50	20	20	4	2	2	2
4	10	50	25	10	6	3	3	3
	11	50	20	15	6	3	3	3
	12	50	15	20	6	3	3	3
5	13	60	20	10	4	2	2	2
	14	60	15	15	4	2	2	2
	15	60	10	20	4	2	2	2
6	16	60	15	10	6	3	3	3
	17	60	10	15	6	3	3	3
	18	60	5	20	6	3	3	3

Extrusion of different snack blends:

The flour blend was separately brought to 18% MC by water addition through material balance (Nwabueze and Iwe, 2010). The prepared samples were extruded at selected constant extrusion condition: screw speed of 140rpm and barrel temperature of 140°C in a Brabender laboratory single-screw extruder (Duisburg DCE 330, New Jersey USA) fitted with 2mm die nozzle.The extruder had grooved barrel length to diameter (L/D) ratio of 20:1 fitted with 2mm die nozzle diameter operated at a constant screw speed (s s) of 140rpm and 140°C barrel temperature. A 4:1 compression ratio screw was employed (Nwabueze, 2007). The die nozzle diameter and length were 2mm and 40mm, respectively. Temperature settings were adjusted using thermostat, such that, feeding, compression, metering and die zone temperatures were 120, 150,170 and 220°C. The extruder was allowed to run to stabilization at a screw speed of 140rpm using corn flour before the experimental runs commenced. The feed was introduced gradually but continuously in to feed hopper equipped with an auxiliary anger screw at 300g/min and received at the die end as strands of pellets. The samples were stored at room temperature (25±5 °C).

Physical properties of extruded different snack blends:

Color of dried snack blends were evaluated in different snack blends made from watercress and measuring the yellowness (b value) and brightness (L value) using a Hunter Lab. Colorimeter apparatus model D 25 according to Francis (1998).Water absorption index (WAI) and water solubility index (WSI) were determined in different snack blends made from watercress seeds according to the method of Anderson *et al*. (1969).The texture profile analysis (TPA) indices of extrusion different snacks blends were determined using a texture analyzer (Cometech, B type, Taiwan).

The conditions of texture analyzer were provided with software, 35 mm diameter compression disc was used. Two cycles were applied at a constant crosshead velocity of 1 mm/s, to 30% of sample depth and then returned. From the resulting force-time curve the values for texture attributes, i.e. Hardness, gumminess, chewiness, adhesiveness, cohesiveness, springiness and resilieness were calculated from TPA graphic according to Bourne (2003).

Sensory properties:

Sensory characteristics such as appearances, crispiness, mouth-feel, and flavor were evaluated in different snack blends made from watercress seeds Within each product and according to the total score, the overall acceptability of the samples were calculated according to the following parameters. Ahmed,. (1999).

RESULTS AND DISCUSSION

Chemical composition of raw materials:

Chemical constituents such as protein, total lipids, crude fiber, ash content and total carbohydrates were determined in corn grits, barley, chickpea, watercress seeds, cumin, black pepper and black cumin and the results are reported in Table (2). From the results in Table (2), it could be noticed that the chickpea had contained the highest in protein content 40.60% followed by watercress seeds, black cumin were 20.80, 21.34 respectively. Meanwhile cumin had contained the medium content in protein 17.81 % followed by black pepper, barley and corn grits protein content were 12.50, 12.01 and 9.50% respectively. Data in Table(2) showed that the chickpea and watercress seeds were higher in total lipid (19.50 and 2.51 %) than black cumin, black pepper, barley, cumin and corn grits were 3.55, 3.30, 2.75, 2.27 and 0.94%, respectively.

Crude fiber and ash were determined in raw materials and the results are reported in Table (2). The resultant showed that the black pepper, chickpea and cumin seeds had contained higher in crude fiber (14.20, 10.78 and 10.50 respectively) followed by black cumin, barley and watercress were 8.47, 8.40 and 9.70 %, respectively. The crude fiber in corn grits was the lowest 0.71% compared with the other raw materials. The ash content in the raw materials was paralleled the crude fiber in raw materials.

Total carbohydrates in the corn grits and barley were the highest (88.20 and 72.16%) than cumin, black pepper, black cumin, watercress and chickpea were 61.02, 61.00, 60.30, 60.59. and 52.25%, respectively. These results are agreement with the results respectively Kushi *et al*. 1999 and Mathers (2002) they showed that the legumes, such as chickpeas, kidney beans and lentils contain many important nutrients and phytochemical; and are present in most Chinese daily diets as good sources of protein, generous amounts of dietary fiber, starch, lipids and minerals. Many researchers have shown the relationship between legume consumption and health benefits, such as, protection from cardiovascular disease, breast cancer, colon cancer, other cancers and diabetes. Legumes are rich in complex carbohydrates and oligosaccharides, important components to human diet for keeping a healthy intestine flora Wood and Grusak (2007). and Shad *et al*. (2009)

Table (2): Chemical composition of raw materials (on dry weight basis g/100g).

Chemical composition	Corn grits	Barley	Chickpea	Watercress seeds	Cumin	Black pepper	Black cumin
Protein	9.50	12.01	40.60.	20.80	17.81	12.50	21.34
Lipids	0.94	2.75	19.50	2.51	2.27	3.30	3.55
Crude fiber	0.71	8.40	10.71	9.70	10.50	14.20	8.47
Ash	0.65	4.68	7.93	6.40	8.40	9.00	6.34
Total carbohydrates	88.20	72.16	22.26	60.59	61.02	61.00	60.30

Chemical composition of prepared snack blends

The results from chemical constituencies of the extrusion snack blends made from watercress are reported in Table (3). From the results in Table (3) it could be notice that the extrusion snack blends made from watercress seeds showed that the protein content was the highest in group No., (2) (blend No., 4, 5 and 6) was amounted 14.93, 16.33 and 17.73 % followed by group No., (1) had contained 14.40, 15.98 and 17.38% compared with control snack (9.24%) made from corn grits. Moreover, the groups No., (3and 4) were decreased slightly in protein content than groups No.,(2 and 1) and it was ranged from 14.38 and 14.73 to 17.18 and 17.53%, respectively and also the groups No., (5 and 6) were the slightly decreased in protein content compared with other groups and ranged from 14.18 and 14.53 to 16.98 and 17.33%, respectively, these increased may be caused which groups 1 and 2 had contained the highest amounted barley than corn grits. These results were increased gradually in protein content by increasing chickpea may be able the legumes is rich in protein content.

Total lipids, crude fiber and ash content were decreased gradually in the snack blends from group (1) 3.80, 5.66 and 3.71% and the highest in total lipids in group No., 2 which contained 5.71, 6.41 and 4.03%, respectively. The groups' no., 5 and 6 were slightly lower and ranged from 3.40 and 3.61 to 4.20 and 4.38%, respectively than other groups and control snack had contained 1.15 %. Whereas, the groups No., 3 and 4 were medium results in total lipids for the extrusion snack blends.

Whereas, total carbohydrates in the snack blends were the lowest in all groups than control (87.28%) as well as the total carbohydrates in the extrusion snack blends were increased from group No., (5) (blends No., 13, 14 and 15) at 75.31, 72.79 and 69.98% followed by group no., (6) (blends No., 16, 17 and 18) was 74.48, 72.06 and 69.45%, respectively. The extrusion snack blends groups' No., 3 and 4 were medium amounted in total carbohydrate and ranged from 73.78 to 68.75% in group No., 3 and also group No., 4 ranged from 72.94 to 67.92%, respectively. Meanwhile, group No., 1 was gradually lower than all groups followed by group No 2. The gradually increase in total carbohydrates caused by the gradually decreased in protein content and total lipid and increased in crude fiber and ash content, respectively, in the snack blends as well as the control snack was the highest in total carbohydrates may be the lowest in protein content, total lipid, crude fiber and ash content than other groups.

Most snack foods produced today consist of starch from cereals, tubers or roots. However, in different countries, popular snacks are already enriched with protein from animal or vegetable origin (Suknark, 1998). However, vegetable proteins are less expensive and can be produced everywhere on earth provided there is some availability of water. Chickpea (Liu, 1997) is excellent sources of proteins that can be used to fortify starch-based snacks.

Table (3): Chemical composition of prepared snack blends (on dry weight basis)

Groups	Different blends	Protein	Lipids	Crude fiber	Ash	Total carbohydrates
Control		9.24 ±1.04 [b]	1.15 ±0.54 [d]	1.38 ±0.37 [c]	0.95 ±0.04 [c]	87.28 ±5.47 [a]
1	1	14.40 ±1.38 [a]	3.80 ±0.68 [c]	5.66 ±0.91 [a]	3.71 ±0.54 [a]	72.43 ±4.12 [b]
	2	15.98 ±1.72 [a]	4.65 ±0.62 [b]	5.81 ±0.95 [a]	3.83 ±0.49 [a]	69.73 ±5.27 [c]
	3	17.38 ±1.56 [a]	5.50 ±0.57 [a]	5.96 ±0.83 [a]	3.94 ±0.29 [a]	67.22 ±6.58 [c]
2	4	14.93 ±1.58 [a]	4.01 ±0.43 [b]	5.84 ±0.76 [a]	3.80 ±0.25 [a]	71.42 ±4.38 [b]
	5	16.33 ±1.39 [a]	4.86 ±0.38 [b]	5.99 ±0.84 [a]	3.91 ±0.27 [a]	68.91 ±6.82 [c]
	6	17.73 ±1.94 [a]	5.71 ±0.46 [a]	6.14 ±0.58 [a]	4.03 ±0.31 [a]	66.39 ±7.16 [c]
3	7	14.38 ±1.27 [a]	3.60 ±0.28 [c]	4.93 ±0.73	3.31 ±0.39 [a]	73.78 ±7.28 [b]
	8	15.78 ±1.68 [a]	4.45 ±0.39 [b]	5.08 ±0.45 [a]	3.43 ±0.37 [a]	71.26 ±6.28 [b]
	9	17.18 ±2.04 [a]	5.30 ±0.48 [a]	5.23 ±0.52 [a]	3.54 ±0.34 [a]	68.75 ±7.81 [c]
4	10	14.73 ±1.68 [a]	3.81 ±0.34 [c]	5.12 ±0.59 [a]	3.40 ±0.40 [a]	72.94 ±8.23 [b]
	11	16.13 ±2.01 [a]	4.66 ±0.48 [b]	5.26 ±0.73 [a]	3.51 ±0.38 [a]	70.44 ±6.58 [b]
	12	17.53 ±2.12 [a]	5.51 ±0.54 [a]	5.41 ±0.83 [a]	3.63 ±0.29 [a]	67.92 ±8.27 [c]
5	13	14.18 ±1.68 [a]	3.40 ±0.28	4.20 ±0.46 [b]	2.91 ±0.21	75.31 ±9.01 [b]
	14	15.58 ±1.89 [a]	4.25 ±0.29 [b]	4.35 ±0.58 [b]	3.03 ±0.18 [a]	72.79 ±8.13 [b]
	15	16.98 ±1.57 [a]	5.10 ±0.38 [a]	4.80 ±0.53 [b]	3.14 ±0.22 [a]	69.98 ±7.11 [c]
6	16	14.53 ±1.48 [a]	3.61 ±0.34 [c]	4.38 ±0.48 [b]	3.00 ±0.19 [a]	74.48 ±6.88 [b]
	17	15.93 ±1.63 [a]	4.46 ±0.43 [b]	4.43 ±0.73 [b]	3.12 ±0.34 [a]	72.06 ±9.17 [b]
	18	17.33 ±2.18 [a]	5.31 ±0.58 [a]	4.68 ±0.29 [b]	3.23 ±0.28 [a]	69.45 ±8.35 [c]

Physical characteristics of extruded snacks blend :

The physical characteristics such as color, water absorption index (WAI) and water soluble index (WSI) in control and their extruded blends made from watercress seeds and the results are presented in Table (4).

Color is a prime factor in judging snacks products quality. The consumers select snacks products for appearance, with the judgment based on the brightness of the color. The results in Table (4) showed Hunter color values of snacks control and its extruded different blends made from watercress seeds. Group no. (6) (blend no., 16, 17 and 18) prepared with 60% corn grits and 15, 10 and 5% barley and also 6% watercress seeds showed that higher in lightness (L value) and yellowness (b value) till 15% chickpea and nearly control snacks followed by group No., (5) (blend No., 13, 14 and 15) made from 60% corn grits and 20, 15 and 10% barley and also till 15% chickpea plus 4% watercress seeds gave the best results for lightness (L value) and yellowness (b value). The gradually decreased color in groups' no. 3 and 4 followed by group No., (1) and group No. (2), respectively. From the obtained results, it could be noticed that the lightness (L value) and yellowness (b value) were decreased after increasing of chickpea and barley concentrations may be caused the barley and chickpea had contained the highest amounted from total dietary fiber and crude fiber. These results are agreed with Ismail *et al*. (2008) opined that low temperature preserved the color, however, prolonged storage, even at low temperature, eventually caused color changes.

Table (4): Physical characteristics of extrusion snack blends with watercress seeds.

Groups	Different blends	Color L	Color a	Color b	WAI*	WSI*
Control		88.14 ±2.18 a	8.97 ±0.15 a	35.71 ±0.91 a	3.30 ±0.08 d	3.00 ±0.07 b
1	1	77.29 ±1.99 b	7.95 ±0.17 b	25.35 ±0.93 b	6.12 ±0.14 a	5.11 ±0.11 a
	2	78.26 ±1.78 b	8.14 ±0.19 a	27.76 ±0.85 b	5.99 ±0.16 b	4.95 ±0.14 ab
	3	78.51 ±1.77 b	8.21 ±0.21 a	27.26 ±0.87 b	5.97 ±0.11 b	4.92 ±0.09 ab
2	4	79.43 ±1.75 b	8.26 ±0.16 a	28.32 ±0.86 b	5.82 ±0.14 b	4.73 ±0.12 ab
	5	79.64 ±1.74 b	8.32 ±0.24 a	28.54 ±0.92 b	5.80 ±0.17 b	4.45 ±0.15 ab
	6	80.42 ±2.04 a	8.43 ±0.28 a	29.76 ±0.94 b	5.73 ±0.16 b	4.42 ±0.13 ab
3	7	82.41 ±2.24 a	8.59 ±0.25 a	29.38 ±0.79 b	5.65 ±0.09 b	4.21 ±0.07 ab
	8	83.32 ±2.65 a	8.65 ±0.29 a	30.28 ±0.98 a	5.59 ±0.17 b	4.12 ±0.14 ab
	9	83.44 ±2.86 a	7.70 ±0.17 b	31.87 ±0.86 a	5.42 ±0.12 b	4.00 ±0.08 ab
4	10	83.78 ±2.37 a	8.75 ±0.31 a	31.29 ±0.90 a	5.27 ±0.11 b	3.98 ±0.09 b
	11	83.78 ±2.37 a	8.75 ±0.30 a	31.29 ±0.82 a	5.02 ±0.07 b	3.95 ±0.04 b
	12	84.55 ±3.01 a	8.81 ±0.29 a	31.55 ±0.92 a	4.84 ±0.08 c	3.82 ±0.06 b
5	13	84.71 ±3.08 a	8.84 ±0.34 a	31.53 ±0.76 a	4.72 ±0.06 c	3.71 ±0.05 b
	14	85.48 ±3.07 a	8.90 ±0.35 a	32..47 ±0.79 a	4.68 ±0.14 c	3.64 ±0.11 b
	15	85.34 ±3.18 a	8.90 ±0.34 a	32.91 ±0.75 a	4.61 ±0.08 c	3.48 ±0.07 b
6	16	85.32 ±3.54 a	8.88 ±0.38 a	32.37 ±0.69 a	4.45 ±0.13 c	3.31 ±0.11 b
	17	85.32 ±3.82 a	8.88 ±0.37 a	32.37 ±1.01 a	4.45 ±0.14 c	3.31 ±0.12 b
	18	86.75 ±4.00 a	8.94 ±0.39 a	33.56 ±1.12 a	4.25 ±0.16 c	3.26 ±0.13 b

WAI: water absorption index, results expressed as weight of gel/gram of dry samples
WSI: water solubility index, result expressed as percent of dry solids in the supernatant.
Huntr color values: L: lightness, b: yellowness, a: redness

Color is an important characteristic of extruded foods. Color changes can provide information about the extent of browning reactions such as caramelization, Millard reaction, degree of cooking and pigment degradation that take place during the extrusion process (Altan *et al.*, 2008).

Water absorption index (WAI) was used to assess this quality factor and water solubility index (WSI) result expressed as percent of dry solids in the supernatant. Water absorption index and water solubility index were determined in the extrusion blends made from watercress seeds and the results are reported in Table (4). The obtained results from Table (4) show that the extrusion different snack blends made from watercress seeds were higher in water absorption index (WAI) than extrusion control. The highest water absorption index was in groups No., (1 and 2) (blends from No., 1 to 6, respectively) made from 40% corn grits and 40, 35, 30 and 25% barley and increased WAI in their extrusion blends by increasing chickpea and barley followed by groups No., (3 and 4) whereas the groups No., (5 and 6) the extrusion different snack blends were nearly extrusion control. Extrusion blends had higher WAI than snacks food control. This may be attributed in part to the high proportion of gelatinized starch found in the extrusion blends. The results were agreement with Debbouz (1992) found a high correlation between WAI and starch gelatinization. Water soluble index (WSI) expresses the percentage of dry matter recovered after the supernatant is evaporated from the water absorption determination. The results in the Tables (6 and 7) showed that slightly difference in water soluble index WSI was found between the extrusion different blends prepared with watercress seeds and also control snacks. Water soluble index WAI reflects the ability of starch to absorb water and is an indirect measure of the amount of intact and fully gelatinized starch granules. The increase in extrudates WAI with increase in screw speed was attributed to an increase in starch gelatinization concomitant with increased SME input (Colonna *et al.*, 1989 and Osman *et al*., 2000).

Texture profile parameter snack blends at zero time:

Data illustrated in Table (5), revealed that texture indices of extrusion snack blends (at zero time) prepared with corn grits, barley, chickpea, cumin, black pepper, black cumin and watercress seeds. From the results, it could be noticed that there were differences in all texture indices between different extrusion snack blends. Hardness of extrusion snack blends made from watercress seeds in Table (5) the resultant showed that the group No., 1 and 2 were increased by reducing corn grits and increasing barley and also ranged 11.86, 11.01 and 10.06 in extrusion blends 1, 2 and 3, and 11.0, 10.0 and 9.13 g in extrusion blends 4, 5 and 6, respectively. Extrusion snack blends in groups No., 3 and 4 were medium hardness and ranged from 7.24 to 10.04 in different groups No., 3 and 4, respectively. The lowest hardness value (5.31) was recorded for blend No., 18 in group No., 6 prepared with 5% barley at 60% corn grits and nearly control was 4.29 followed by blends No., 15 and 17 in groups No., 5 and 6 were 6.26 and 6.27 and it was prepared 10% barley at 60% corn grits. From these results, it could be notice that when corn grits increased and barley decreased the hardness was decreased and also equal control made from corn grits.

Table (5): Texture profile analysis (TPA) in snack blends .

Group	Different blends	Hardness (N)	Cohesiveness (%)	Gumminess (g)	Chewiness (g/mm)	Springiness (mm)
Control		4.29 ±1.11 ^{c}	0.51 ±0.08 ^{c}	2.19 ±1.28 ^{c}	1.31 ±0.94 ^{c}	0.60 ±0.07 ^{c}
	1	11.86 ±2.15^{a}	2.15 ±1.03 ^{a}	20.50 ±3.25 ^{a}	17.13 ±3.58 ^{a}	0.84 ±0.08^{a}
1	2	11.01 ±2.38 ^{a}	1.94 ±0.95 ^{b}	18.60 ±3.11 ^{b}	14.90 ±3.21 ^{a}	0.81 ±0.05 ^{a}
	3	10.06 ±1.98 ^{a}	1.73 ±0.35 ^{b}	14.71 ±3.69 ^{b}	12.67 ±2.48 ^{a}	0.78 ±0.06 ^{b}
	4	11.00 ±2.57 ^{a}	1.95 ±0.28 ^{b}	18.61 ±4.21 ^{b}	14.91 ±3.27 ^{a}	0.81 ±0.02 ^{a}
2	5	10.00 ±1.99 ^{a}	1.75 ±0.22 ^{b}	14.72 ±2.35 ^{b}	12.77 ±2.14 ^{a}	0.78 ±0.07 ^{b}
	6	9.13 ±1.87	1.52 ±0.35 ^{b}	11.82 ±3.26 ^{b}	10.45 ±1.98 ^{a}	0.75 ±0.05 ^{b}
	7	10.04 ±2.54 ^{a}	1.74 ±0.65 ^{b}	14.71 ±3.56 ^{b}	12.76 ±2.68 ^{a}	0.78 ±0.09 ^{b}
3	8	9.11 ±2.15 ^{ab}	1.51 ±0.52 ^{b}	11.81 ±3.17 ^{b}	10.44 ±2.49 ^{a}	0.75 ±0.08 ^{b}
	9	8.16 ±2.11 ^{ab}	1.31 ±0.43 ^{b}	8.92 ±2.58 ^{ab}	8.23 ±2.64 ^{ab}	0.72 ±0.07 ^{b}
	10	9.13 ±2.38 ^{ab}	1.52 ±0.48 ^{b}	11.81 ±2.67 ^{b}	12.44 ±2.86 ^{a}	0.75 ±0.02 ^{b}
4	11	8.17 ±2.04 ^{ab}	1.32 ±0.61 ^{b}	8.91 ±2.61 ^{ab}	8.22 ±2.61 ^{ab}	0.72 ±0.04 ^{b}
	12	7.24 ±1.57 ^{ab}	1.10 ±0.83 ^{b}	6.15 ±2.14 ^{ab}	6.01 ±2.28 ^{ab}	0.69 ±0.06 ^{c}
	13	8.14 ±2.57 ^{ab}	1.31 ±0.64 ^{b}	8.92 ±2.65 ^{ab}	8.23 ±2.27 ^{ab}	0.72 ±0.04^{b}
5	14	7.20 ±2.16^{ab}	1.10 ±0.28 ^{b}	6.16 ±2.18 ^{ab}	6.00 ±2.10 ^{ab}	0.69 ±0.06 ^{c}
	15	6.26 ±2.38 ^{b}	0.89 ±0.11 ^{c}	4.12 ±1.98 ^{b}	4.79 ±2.13 ^{b}	0.66 ±0.04 ^{c}
	16	7.21 ±2.97 ^{ab}	1.11 ±0.35 ^{b}	6.15 ±2.18^{ab}	6.00 ±2.08^{ab}	0.69 ±0.06 ^{c}
6	17	6.27 ±2.86^{b}	0.90 ±0.27 ^{c}	4.11 ±2.17^{b}	4.79 ±1.95^{b}	0.66 ±0.03 ^{c}
	18	5.31 ±1.54^{c}	0.65 ±0.09 ^{c}	3.21 ±1.68^{c}	2.56 ±0.98^{c}	0.63 ±0.05^{c}

Cohesiveness values ranged from 0.65% to 2.15% showed differences between different extrusion snack blends. The highest cohesiveness value was recorded for snack blend No., 1 in group 1 was prepared with 40% corn grits at 40% barley and 10% chickpea. On the contrary, the lowest value (0.51%) was recorded for control made from corn grits and nearly or equal extrusion blend No., 18 in group 6 (0.65%. The slightly differences and gradually decrease were observed in cohesiveness between the groups' No., 2, 3, 4, and 5, respectively.

Gumminess of different extrusion snack blends ranged from 3.21 to 20.50 g showed differences. Gumminess of extrusion snack blends was increased by reducing barley level. Extrusion snack blend prepared by 40% corn grits at 40% barley and 10% chickpea had higher (20.50 g) in Gumminess values than that prepared with 5% barley and 60% corn grits 3.21% and nearly or equal control (2.19 g) made from corn grits. The highest value was recorded in groups' No., 1 and 2 for extrusion snack blends prepared with 40% corn grits and 40, 35, 30 and 25% barley ranged from 11.82 to 20.50 g followed by extrusion snack blends was recorded in groups No., 3 and 4 prepared with 50% corn grits and 30, 25, 20 and 15% barley ranged from 6.15 to 14.71 g with differences between them. On the other hand, no differences were recorded between extrusion snack blends in groups' No., 5 and 6 prepared with 60% corn grits and 50, 15, 10 and 5% barley ranged from 8.92 to 6.15 g, respectively.

Chewiness value was recorded 1.31 g/mm in control sample prepared with corn grits and the different extrusion snack blends were ranged from 2.56 to 17.13 g/mm made from corn grits, barley, chickpea, watercress, black pepper, cumin and black cumin, respectively. Chewiness values were increased by barley replacers' percentages increment. Also different extrusion snack blends prepared with 40% corn grits, 40, 35, 30 and 25% barley and 10, 15 and 20% chickpea had higher chewiness values than that prepared with 60% corn grits and 20, 15, 10 and 5% barley and 10, 15 and 20% chickpea. Meanwhile, different extrusion snack blends prepared with 50% corn grits, 30, 25, 20 and 15% barley and 10, 15 and 20% chickpea had medium chewiness values.

Springiness value was recorded 0.60 mm in control sample prepared with corn grits and the different extrusion snack blends were ranged from 0.60 to 0.84 mm showed slightly differences between all different extrusion snack blends.

From the obviously results, it could be noticed the texture profile analyses in different extrusion snack blends made from watercress seeds showed that the groups No., 5 and 6 made from 60% corn grits and 20, 15, 10 and 5% barley and 10, 15 had contained the lowest total dietary fiber and crude fiber therefore these extrusion blends give the best results in the texture profile analyses. Moreover the groups' No., 1 and 2 had contained the highest total dietary fiber and crude fiber and extrusion blends give the lowest results in the texture profile analyses followed by groups' No., 3 and 4 give the medium results in the texture profile analyses.

Texture, defined as the sensory manifestation of food structure and the way in which this structure reacts to the forces applied, represents the junction of all the mechanical, geometric and superficial attributes of a product, sensed through mechanical, tactile, visual and hearing receptors (Szczesniak, 1963a). Moreover, texture can be related to the deformation, disintegration and flow of the food when a force is applied (Bourne, 2002).

Sensory properties of snack blends :

Appearance, crispiness, mouth-feel, flavor and overall acceptability of the extruded blends made from watercress seeds and control snack made from corn grits were evaluated by twenty sensory judge and the results are reported in Table (6).

The results from sensory properties of extrusion snacks made from watercress seeds are reported in Table (6). From the resultant, it could be notice that the group (No. 6) (blends No., 16, 17 and 18) consists of 60% corn grits plus 15, 10 and 5% barley were added separately to 10, 15 and 20% chickpea and it was mixed with 3% for each cumin, black pepper and black cumin, respectively were mixed with 6% watercress seeds gave the best overall acceptability. The extrusion blend no., 18 made from 20% chickpea and 5% barley the highest acceptability (93%) and nearly or equal control (96%) followed by 10 and 15% chickpea plus 15 and 10% barley were gave 89.0 and 91.0% during overall acceptability. Black pepper as a spices had to play in enhancing the taste and flavor of the snack blends and cumin seeds were used as a spice for their special aromatic effect of the snack blends. Moreover, the group (No. 5) (blend No., 13, 14 and 15) prepared with 60% corn grits and 20, 15 and 10% barley were added separately to 10, 15 and 20% chickpea and it was mixed with 2% for each cumin, black pepper and black cumin, respectively were mixed with 4% watercress seeds and the results observed that 91, 89 and 89% on overall acceptability. These results caused when the increased corn grits and decreasing fiber derived from barley and chickpea in the snacks blends, the overall acceptability was the best.

The group (No. 4) (blend No., 10, 11 and 12) consists of 50% corn grits plus 25, 20 and 15% barley were added separately to 10, 15 and 20% chickpea and it was mixed with 3% for each cumin, black pepper and black cumin, respectively were mixed with 6% watercress seeds. The results from the same table illustrated that the group No.4 at different levels from chickpea were 82.0, 85.0 and 86.0% on overall acceptability. As well as the group No.3 (blend No., 7, 8 and 9) at different levels 10, 15 and 30% from chickpea plus 30, 25 and 20% barley and it was mixed with 2% for each cumin, black pepper and black cumin, respectively were mixed with 4% watercress seeds were 80.0, 81.0 and 82.0% during overall acceptability. These results showed that medium acceptability may be corn grits and barley were medium weigh than groups' No. 5 and 6 and also chickpea was the same weigh in the groups.

Table (6): Sensory properties of snack blends .

Groups	Different blends	Appearance (25)	Crispiness (25)	Mouth-feel (25)	Flavor (25)	Overall acceptability (100)
Control		24.0 ±2.13[a]	24.0 ±2.45[a]	24.0 ±2.14[a]	24.0 ±3.15[a]	96.0 ±10.24[a]
1	1	19.0 ±1.92[c]	17.0 ±1.09[c]	19.0 ±1.86[c]	19.0 ±1.86[c]	74.0 ±6.52[b]
	2	19.0 ±1.67[c]	17.0 ±1.17[c]	20.0 ±2.16[b]	19.0 ±1.67[c]	75.0 ±5.84[b]
	3	19.0 ±1.83[c]	17.0 ±1.34[c]	20.0 ±2.62[b]	20.0 ±1.73[b]	76.0 ±6.73[b]
2	4	19.0 ±1.59[c]	18.0 ±1.57[b]	20.0 ±2.58[b]	20.0 ±2.54[b]	77.0 ±8.21[b]
	5	20.0 ±2.34[b]	18.0 ±1.82[b]	20.0 ±2.43[b]	20.0 ±2.19[b]	78.0 ±8.37[b]
	6	20.0 ±2.71[b]	18.0 ±1.11[b]	21.0 ±2.76[ab]	20.0 ±2.68[b]	79.0 ±7.69[b]
3	7	20.0 ±2.95[b]	19.0 ±2.38[ab]	21.0 ±2.74[ab]	20.0 ±2.23[b]	80.0 ±7.98[ab]
	8	20.0 ±2.37[b]	19.0 ±2.19[ab]	21.0 ±2.96[ab]	21.0 ±2.94[ab]	81.0 ±9.12[ab]
	9	21.0 ±2.48[ab]	19.0 ±2.21[ab]	21.0 ±2.39[ab]	21.0 ±2.38[ab]	82.0 ±9.38[ab]
4	10	21.0 ±2.29[ab]	19.0 ±2.38[ab]	21.0 ±2.16[ab]	21.0 ±2.86[ab]	82.0 ±9.77[ab]
	11	21.0 ±2.67[ab]	20.0 ±2.47[ab]	22.0 ±2.24[ab]	22.0 ±2.41[ab]	85.0 ±10.16[ab]
	12	22.0 ±3.01[ab]	19.0 ±2.68[ab]	22.0 ±2.35[ab]	23.0 ±3.01[a]	86.0 ±10.28[ab]
5	13	22.0 ±2.38[ab]	19.0 ±2.66[ab]	22. 0 ±2.87[ab]	23.0 ±3.16[a]	86.0 ±10.67[ab]
	14	22.0 ±2.82[ab]	21.0 ±2.53[a]	22.0 ±2.59[ab]	22.0 ±2.86[ab]	87.0 ±10.38[ab]
	15	22.0 ±3.12[ab]	20.0 ±2.77[ab]	22.0 ±2.79[ab]	23.0 ±2,84[a]	87.0 ±9.97[ab]
6	16	22.0 ±2.91[ab]	21.0 ±2.52[a]	23.0 ±2.45[a]	23.0 ±2,98[a]	89.0 ±10.57[ab]
	17	23.0 ±2.83[a]	21.0 ±2.95[a]	23.0 ±2.46[a]	24.0 ±3.12[a]	91.0 ±11.11[a]
	18	23.0 ±3.11[a]	22.0 ±2.46[a]	24.0 ±02.61[a]	24.0 ±3.24[a]	93.0 ±1.24[a]

The group No. 2 (blend No., 4, 5 and 6) had contained 40% from corn grits was added separately to 10, 15 and 20% chickpea plus 3% other ingredients and 6% watercress seeds were mixed with 35, 30 and 25% barley. Moreover, the group No. 1 (blend No., 1, 2 and 3) had contained 40% from corn grits was added separately to 10, 15 and 20% chickpea plus 2% other ingredients and 4% watercress seeds were mixed with 40, 35 and 30% barley. From the resultant, it could be noticed that the groups' No. 1 and 2 were the lowest score in overall acceptability than other groups and control. The lowest score may be caused decreases in the proportion of corn, which lead to higher fiber derived from barley and chickpea. These results are agreement with Singh *et al.* (2003) who found that the dietary fibers which is highly water-binding macromolecules is competing with starch for water absorption and hence limiting starch swelling and gelatinization resulting in a higher endothermic peak temperatures value.

From the results it could be recommended that the different extrusion snack blends made from watercress seeds showed that the group's No., 5 and 6 incoroded from 60% corn grits and 20, 15, 10 and 5% barley and 10, 15% chickpea gave the best results. The conclusion from different obtained data showed that different samples of snack made from corn grits using other materials have high nutritive value, Sensory test and Statistical evaluations compared with those made from corn grits.(100%).

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إنتاج مقرمشات صحية بإستخدام بعض الحبوب والأعشاب المنتشرة فى مصر

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تم اعداد وجبة خفيفه من البثق الحرارى تحتوى على خلطات من الذره والشعير والحمص والجرجير والكمون والفلفل الاسود وحبة البركه بنسب مختلفه تحتوى على ١٩ خلطه ثم تم عمل الاختبارات اللازمه للخصائص الفزيائيه والحسيه للنتائج.

اظهرت النتائج ان الحمص يحتوى على نسبة عاليه من البروتين والدهون الكليه بنسبة ٤٠.٦٠ و١٥.٥٠ على التوالى. وكان الفلفل والحمص وحبة البركة تحتوى على نسبة عاليه من الالياف الخام بنسبة ١٤.٢٠ , ١٠.٧١ , ١٠.٥٠على التوالى.

اما خلطة بذور الجرجير ظهر ان البروتين كان فيها اعلى فى العينة رقم ٢ وكانت بنسبة البروتين فى العينات رقم ٤ , ٥ , ٦ مرتفعه (١٥.٠٤ , ١٦.٤٤ , ١٧.٨٢%) بينما انخفضت نسبة الدهون والالياف الخام والرماد تدريجيا فى العينه رقم ١ هى ٤.٠٢ , ٤.٨٧ , ٥.٧٢ على التوالى.

وكانت نسبة الدهون الكلية فى العينة رقم ٢ هى ٤.٢٣ , ٥.٠٨ , ٥.٩٣ على التوالى .

واظهرت العينه رقم ٦ (١٦ , ١٧ , ١٨) والمعده من ٦٠% من الذره ١٥ , ١٠ , ٥% من الشعير وايضا ٦% من الجرجير اظهرت فى ارتفاع قيمة اللون (L) ودرجة الاصفرار (b) حتى ١٥% من اضافة الحمص.

وكانت اعلى مؤشرات فى نسبة امتصاص الماء (WAI) ومؤشر للزوبان فى الماء (WSI) فى المجموعتين رقم ١ , ٢ (١ , ٦ على التوالى) والمصنعه من ٤٠% من الذره و٢٥،٣٠،٣٥،٤٠% من الشعير.

وكانت الخصائص الحسيه كالتالي العينه رقم ١٨ والمصنعه من ٢٠% من الحمص و ٥% من الشعير. كانت اعلى فى درجة القبول (٩٣%) وكانت تقارب او تساوى درجة الكنترول (٩٦%) وتليها العينه التي تحتوي علي ١٠ , ١٥% من الحمص لاقت درجة قبول ٨٩%.

وفى المرتبة الثالثه العينه التي تحتوي علي ١٥ , ١٠% من الشعير لاقت درجة قبول (٩١%).

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