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Utilization of Germinated Pumpkin Seed Flour and Steamed Broken Rice For Preparation Infant Formula

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ABSTRACT

Complementary infant foods are used to transition infants from breast milk to an adult diet. Protein quality is necessary for the growth and development of infants to produce infant food, we used germinated pumpkin seed flour and steamed broken rice. Raw pumpkin seed was germinated and oven-dried at 50 ^{o}C. Raw pumpkin seed flour (RPSF) and germinated pumpkin seed flour (GPSF) were studied (gross chemical composition, amino acid content and fatty acid profile). The results indicated that the germination process improves features of RPSF. There was an increase in protein, fiber, ash, amino acid and fatty acid contents. Then germinated pumpkin seed flour (GPSF), steamed broken rice, skimmed milk powder, sugar, lecithin, salt and vanilla were used to prepare six formulas for infants (6 months - 2 years). In sensory evaluation, the formulas were compared with the control product (Cerelac with rice) to select the best formulas for consumption. We selected formula 1 (F1), formula 2 (F2) and control according to the results of sensory evaluation. The gross chemical composition, amino acid content, Chemical Score (CS), protein efficiency ratio (PER), biological value (BV), minerals content, physical characteristics and peroxide value during storage for 6 months were estimated to evaluate the formulas. These results indicate the good nutritional quality of protein and all estimated parameters for the prepared formulas compared to the control.

1. Introduction

The growth of the infant in the first or second years is very fast, and breastfeeding alone is insufficient to meet the child's nutritional requirements. After about four months of age, the child needs supplementary feeding. (Elemo, 2011). Full-term exclusively breastfed infants usually maintain suitable iron status during the first six months of life due to the transmission of fetal iron stores. After 4–6 months, infants should receive additional iron. Weaning foods are complementary in nature because they complement the mother's milk. The main purpose of introducing these foods is a) to supply taste and variety to the baby's diet; b) to provide the missing nutrients; c) to inform the baby of swallowing, chewing, and eating skills; and d) to habituate the child to the exact flavor and taste of home meals. Start with liquids, then semisolids, and finally normal home foods (Srivastava et al., 2015).

Good-quality weaning food should have high nutrient density, bulk density, low viscosity, and a convenient texture, along with high energy, protein, and micronutrient contents, and must have a consistency that allows easy consumption (Balasubramanian et al., 2014). Current guidelines advise that cereals given to infants less than six months of age should preferably be gluten-free. Whenever there is a family history of celiac disease, further delay in the introduction of foods containing gluten may be considered appropriate. In general, the following foods containing gluten are not advised before six months: all varieties of bread, most rusks, whole or ground, wheat-based cereals, oats or oat cereals, and multigrain cereals (Sajilata et al., 2002). Pumpkin (Cucurbita pepo) is an annual medicinal plant that belongs to the Cucurbitaceae family. (Abd El-Majied et al., 2008) mentioned that pumpkin has recieved

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large attention mainly due to the health and nutritional protective values of its seeds which are a good source of zinc. Pumpkin seeds are commonly considered as waste, but they have a high content of fatty and amino acids, which when used as a by-product or ingredient can add value to food products (Crosby-Galvan et al., 2018). Pumpkin seeds belonging to are a good source of protein, essential fatty acids, potassium, calcium, manganese and magnesium (Akwaowo et al., 2000 and Seo et al., 2005). Pumpkin seeds are known to supplement the release of bioactive compounds, to enhance antioxidant activity and bioavailability of essential minerals of such seeds (El-Refai et al., 2012).Moreover, Pumpkin seeds are distinctive in flavor and nutty-tasted, which can be picked as snacks in salted-roast or unroasted form, whereas the kernels are used in baking, cooking and in gravies and soups as flavor improvers. These days, pumpkin seeds are sold as sprouted, fermented, or pumpkin protein isolate (Syed et al.,2019), as the pumpkin seeds are immensely nutritional and fortified with nutraceuticals such as carotenoids, phytosterols, phytoestrogens, triterpenes, tocopherols, lignans, and saponins; these compounds termed as phenolic compounds or secondary metabolites with significant antioxidative capacity (Caili et al.,2006). The seeds and oils extracted from pumpkin seeds contain vitamin E and beta-sitosterol and are used in medicinal industries (Chevallier, 1996). In most African countries such asTunisia and Egypt, pumpkin seeds are mainly salted and roasted and consumed as a snack and might also be cooked, ground (west Africa) and fermented for utilization as a flavor enhancer in soups and gravies. (Rezig et al., 2013 and Nwokolo and Sim, 1987).Also, pumpkin seeds are used for supplementation up to 10%, which increases protein, lysine, total sulfur amino acids, mineral contents, protein digestibility, crude fat and ash of the final product than using 100% wheat flour. (El-Soukkary, 2001). In the same direction, Ward and Ainsworth (1998) reported that a cooked gruel blended with ground pumpkin seeds, which was provided to infants 4-6 months old in Kenya, resulted in an 82.5% increase in protein digestibility. Sufficient unsaturated fatty acids from the mix can prevent eczema and promote resistance to hypersusceptibility. On the other hand, processing techniques used for formulating complementary foods, such as soaking, germination, fermentation, and roasting, improve the bioavailability of micronutrients by decreasing antinutritional factors and enhancing overall digestibility and absorption of nutrients. Such processing techniques also reduce the high bulk of complementary foods by reducing their viscosity (Rasane et al., 2015).

For centuries, the process of cereal seed germination has been used for the purpose of softening the kernel structure, improving its nutritional value, and reducing anti-nutritional effects (Kaukovirta-Norja et al.,2004) reported that the germination process is one of the methods used to improve the functionality of oat seed protein In spite of the known nutritional benefits of germinated pumpkin seeds, the effort that has been made to develop weaning foods was very little, perhaps because the preparation of germinated flour is rather time-consuming [Mosha, 1987]. Many studies have reported the use of pumpkin seed flour with cereals such as wheat, corn, rice, and oats (Lkujenlola et al., 2013). However, there is limited research on the use of it in the formulation of complementary foods.

The objective of the present investigation was to develop nutrient-dense, safe, low-cost infant food from the combination of rice and germinated pumpkin seeds.

2. Materials and Methods

Materials

Pumpkin *(Cucurbita pepo)* fruits, broken rice, skimmed milk powder, salt, sugar, lecithin and vanilla were purchased from the local market.

Methods

Preparation of pumpkin seed flours

Raw pumpkin seed flour

Mature pumpkin fruits were harvested and opened using a sharp knife. The seeds were manually removed, rinsed with water, allowed to drain in a strainer and dried in an oven at 50^{o}C using a hot air rapid drying oven. The dried seeds were peeled then

then Milled by a grinder and sieved through a 60 mesh (British standard screen). The fine pumpkin seed flour was packaged and stored in the refrigerator at 4 °C (El-Adawy and Taha, 2001).

Germinated Pumpkin Seed Flour

Fresh pumpkin seed was soaked in water for 12 h after which the water was drained, the steeped pumpkin seeds were spread on a moistened jute bag, covered and left for 3 days with regular wetting and turning of seeds. After sprouting, the seeds were soaked in hot water (60±5 °C) for 1 hour then washed with water and finally dried in the oven at 60 °C for 4 h. After drying, the sprouts seeds were peeled and milled into flour, then sieved and kept in refrigerator at 4 °C. The result is the same as the findings of (El-Adawy and Taha 2001) on some oilseeds.

Preparation of steamed broken rice flour

Broken rice was cleaned, washed and steamed. It was dried at 50°C, milled, sieved (sieve: 0.700 μm mesh size) and stored in refrigerator at 4 °C until used (Hasbullah et al., 2017)

Formulation

Six formulas were formulated and Cerelac rice (control). Table 1. shows the proportions of the materials.

Table 1. Ingredients of the different formula's diets

Ingredients (g)	F1	F2	F3	F4	F5	F6	Control
Steamed broken rice	76.87	66.87	56.87	46.87	41.87	86.87	Cerelac (rice)
pumpkin seeds flour	10	20	30	40	45	0	
Skimmed milk powder	5	5	5	5	5	5	
Sugar	5	5	5	5	5	5	
Lecithin	3	3	3	3	3	3	
Salt	0.1	0.1	0.1	0.1	0.1	0.1	
Vanilla	0.03	0.03	0.03	0.03	0.03	0.03	
Total	100	100	100	100	100	100	

Analytical techniques

Analysis of raw and germinated seed flour

Gross chemical composition

The gross chemical composition of raw and germinated seed flour was determined according to the Association of Official Analytical Chemists (AOAC, 2005). Total carbohydrates were calculated by the difference.

Determination of amino acid content

The amino acid content of raw and germinated pumpkin seed flour was determined following the methods of AOAC (2005) and Benitez (1989). About 200 mg of dried defatted pumpkin seed flour was hydrolyzed using 7 ml of 6 N HCl at 105 °C for 22 h. and the hydrolysate was filtered. The residue was rinsed with distilled water while the filtrate was evaporated in the water bath at 40 °C. The amino acid content of the samples was determined using a PHT amino acid analyzer (model 120A). Tryptophan was determined after alkali (NaOH) hydrolysis by a calorimetric method (Freidman and Finely, 1971).

Determination of fatty acid profile

The fatty acid methyl esters (FAME) were analyzed using gas chromatography (Varian 3600 GC, Mississauga, ON). The data were processed using a Class-VP data processor (Shimadzu Corporation, Columbia, MD). The FAMEs were separated on a fused silica capillary column (50 m x 0.32 mm, BPx -70, SGE Column, Pty. Ltd, Victoria, Australia) with a film thickness of 0.25 mm and temperature of 230 °C (Bozan and Temelli, 2002).

Evaluation and analysis of prepared formulas

Sensory evaluation

Three fresh formulas were sensory evaluated at zero time to select the best formulas for consumption according to (Metwalli et al., 2011) by ten well - trained panelists from the staff members of

Food Technology Research Institute at ARC. The scoring scheme was proved for texture, color, taste, aroma, mouthfeel and overall score.

Gross chemical composition

Moisture, protein, crude fiber, fat and ash contents of the prepared formulas were determined according to the method described in AOAC (2005). Total carbohydrates were calculated by difference. Total calories were calculated according to the following equation:

Total calories = 4(protein+Carbohydrates) + 9 (fat)

Determination of amino acid content, Chemical Score (CS), Protein Efficiency Ratio (PER) and Biological Value (BV)

The amino acid content of prepared formulas was determined by the method of AOAC (2005) and Benitez (1989). Tryptophan was determined after alkali (NaOH) hydrolysis by a calorimetric method (Freidman and Finely, 1971). Chemical Score was calculated according to FAO/WHO pattern (1991)

$$C.S. = \frac{mg\ of\ essential\ amino\ acid\ in\ g\ test\ protein}{mg\ of\ essential\ amino\ acid\ in\ the\ requirement\ pattern}$$

Protein Efficiency Ratio (PER) was calculated using the equation suggested by (Alsmeyer et al., 1974).

PER= -0.684+0.456 Leucine-0.047 Proline (g/100g protein)

Biological Value (B.V) was calculated according to the equation of (Oser 1959).

B.V= 49.9+10.53 PER

Minerals content

Iron, calcium, zinc and phosphorus of prepared formuals were accomplished by Atomic Absorption Spectrophotometer (Varian Spectra 4, Varian Australia Pty., Ltd., Mulgrave, Vic.3171, Australia). The ashed samples were prepared using the (A.O.A.C. 2000) method.

3.2.5. Physical characteristics:

Water absorption index (WAI), water solubility index (WSI) and water retention were determined by prepared formulas according to (Sefa-Dedeh et al., 2003). Specific weight was measured according to (Phillips et al., 1984).

Peroxide value of lipids during storage

The prepared formulas were packed in polyethylene bags (200 g each), sealed and kept at room temperature. The samples were examined for peroxide value. It was determined according to the method described in the (A.O.A.C. 2000) at zero time and after 2, 4 and 6 months of storage.

Statistical methods

The results of sensory evaluation and compositions are means ± standard deviation (SD) using the Excel program under Windows Differences between prepared formulas were analyzed by ANOVA using SPSS (Release 11.01, SPSS Inc., and Chicago, IL, USA), (Hulshof, et al., 2006).

Results and Discussion

Raw and germinated seed flour

Gross chemical composition

Table 2. revealed the gross chemical composition of raw and germinated pumpkin seed flour. Significant increases were observed in protein and fiber of GPSF than RPSF. On the other hand, Significant decreased were shown in fat, ash and total carbohydrate of GPSF than RPSF. (Fagbemi et al., 2005) showed that germination improved the nutritional quality of food products, especially the protein content. Additionally, germination has been shown to significantly increase crude protein content and the levels of the protein fractions albumin and globulin of pumpkin seed (Giami et al., 1999). The fat content (47.5 and 44.9%) of raw and germinated pumpkin seed flour respectively, was observed to reduce during germination. It may be suggested that shelf life of pumpkin seed flour will be prolonged as the rate of rancidity will the shelf be slow and contribute to the low energy of the samples (Fasasi, 2009). Germinated pumpkin seed flour was found to possess the highest fiber content (7.52%), followed by raw (6.71%). The ash content of raw and germinated pumpkin seed flour was 5.32% and 4.77%, respectively. Significantly reduced the ash content of pumpkin seeds which is parallel to observations of (Ohtsubo et al., 2005). The result agrees with previous reports which suggested that the germination.

Amino acid content

The essential and non-essential amino acid profile of pumpkin seed flour is presented in Table 3. It was observed that germination results show some improvement in the amount of amino acidspresent in pumpkin seed flour. The result from this study supports earlier studies by (Ijarotimi 2012) and Shemi 2013) who observed increases and decreases in some amino acids after germination.

The values of the total non-essential amino acid of raw and germinated pumpkin seed flour were higher than the total essential amino acid.

Table 3. Amino acid content (mg/g protein) of raw and germinated pumpkin seed flour

Amino acid	RPSF	GPSF
Essential amino acid (E.A.A.)		
Threonine	3.15	2.89
Valine	4.53	5.21
Leucine	6.41	7.23
Isoleucine	3.75	4.83
Tyrosine	3.37	4.52
Phenylalanine	4.61	5.72
Cysteine	0.89	0.84
Methionine	2.45	3.31
Lysine	5.71	6.12
Histidine	2.52	2.98
Tryptophane	1.62	1.68
Total E.A.A.	38.65	45.33
Nonessential amino acid (N.E.A.A.)		
Aspartic acid	8.25	5.59
Glutamic acid	12.39	14.08
Serine	3.68	4.02
Proline	3.08	3.91
Glycine	2.19	3.48
Alanine	5.49	4.25
Arginine	10.41	11.06
Total N.E.A.A.	45.49	46.39

RPSF: Raw pumpkin seed flour GPSF: Germinated pumpkin seed flour.

Fatty acid profile

Data in Table 4 shows the fatty acid profile of raw and germinated pumpkin seed flour. The most abundant saturated fatty acids in raw and germinated pumpkin seed are palmitic acid (62.39 and 112.37 µg/ml) and stearic acid (35.81 and 67.85 µg/ml) while linoleic acid (141.26 – 275.31 µg/ml) is found to be the most abundant unsaturated fatty acid. Polyunsaturated fatty acid, ND*: Not detected the result is like the findings of (El-Adawy and Taha 2001) on some oilseeds. The high percentage of polyunsaturated fatty acid (PUFA) in the pumpkin seed flour may enable it to exhibit some nutritional benefits. High consumption of PUFA was reported to decrease the risk of coronary heart disease (El Sohaimy, 2012). The ratio of PUFA: total saturated fatty acid (TSFA) was the highest in germinated (1.37 µg/ml) than in raw (1.77 µg/ml) pumpkin seed flour. Pumpkin seed oil may find application in cooking and other industrial food production processes where oil that is rich in fatty acids is desired.

Table 4. Fatty acid profile (µg/ml) of raw and germinated pumpkin seed flour

Fatty acids	Carbon chain	RPSF	GPSF
Myristic	C14:0	16.52	17.29
Palmitic	C16:0	62.39	112.37
Palmitoleic	C16:1	35.98	91.43
Margaric	C17:0	10.21	11.09
10Z Heptadecenoic	C17: 1	ND*	8.57
Stearic	C18:0	35.81	67.85
Linoleic	C18:2	141.26	275.31
Linolenic	C18:3	81.32	165.48
Arachidic	C20:0	18.32	20.14
Gondoic	C20:1	9.96	11.04
Behenic	C22:0	18.83	19.42
TSFA		162.08	248.16
MUFA		45.94	111.04
PUFA		222.58	440.79
PUFA/TSFA		1.37	1.77

RPSF: Raw pumpkin seed flour, GPSF: Germinated pumpkin seed flour.
TSFA: Total Saturate Fatty Acid, MUFA: Monounsaturated fatty acid, PUFA

Prepared formulas

Sensory evaluation

Sensory evaluation of the prepared formulas was considered one of the important tests affecting the acceptability of foods. The tested samples were prepared in the form of puree by adding a suitable amount of warm water to select the best formulas for consumption. The formulas selected have been analyzed. Six prepared formulas and control (Cerelac with rice) were tested to texture, color, taste, aroma, mouth feel and overall. Data in Table 5. indicated that there was no significant difference in all tested characteristics between F1 and the control. Additionally, there is no significant difference overall between F2 and the control. On the other hand, the results showed that significantly decreased difference in F3, F4, F5 and F6 compared to the control. So, we selected F1, F2 and control to analyze. Generally, (Sanni et al., 1999 and Sefa-Dedeh et al., 2003) cited that germination and fermentation had a positive effect on texture, taste and aroma.

Table 5. Sensory evaluation of prepared formula at zero time

	F1	F2	F3	F4	F5	F6	Control
Texture	9.1 ^{a} ±1.19	8.75^{b}±1.10	8.7^{a}±0.91	8.5^{b}±0.91	8.2^{b}±0.98	7.9^{b}±0.86	9.2 ^{a} ±1.19
Color	8.9 ^{a} ±0.99	8.45^{c}±0.83	8.4^{b}±0.86	8.3^{a}±0.86	8.3^{b}±0.83b	8.1^{a}±1.19	8.9 ^{a} ±0.99
Taste	9.1 ^{a}±0.99	8.95^{b}±0.74	8.65^{a}±0.99	8.5^{c}±0.99	8.1^{b}±1.18b	7.9^{c}±0.99	9.0 ^{a}±0.99
Aroma	8.9 ^{a} ±1.10	8.5^{c}±1.032	8.3^{b}±1.08	8.3^{b}±1.08	8.2^{b}±1.03b	8.0^{b}±1.10	8.8 ^{a} ±1.10
Mouth feel	8.7 ^{a} ±1.23	8.6^{bc}±0.918	8.5^{ab}±1.25	8.3^{a}±1.25	8.3^{b}±1.16b	8.1^{a}±1.14	8.6 ^{a} ±1.23
Overall	9.4^{a}±0.98	9.2^{a}±0.96	8.7^{a}±1.05	8.4^{c}±1.05	8.2^{b}±0.89	7.9^{b}±0.56	9.2^{a}±0.98

Within the same column values not sharing the same letter are significantly ($p \leq 0.05$)

Gross chemical composition

According to the chemical analysis of germinated pumpkin seed flour used in the preparation of formulas. Trials were taken place to form formulate infant food formulas by mixing the ingredients to obtain covered the Recommended Dietary Allowances (RDA) of infants from 6 to 12 months from protein of not less than 14 % (RNI 2000). (Niinikoski et al., 1997) showed that term infants older than 6 months of age grow normally with a diet providing only approximately 30% of energy as fats. These formulas are supplemented with lecithin and germinated pumpkin seed flour to supply the requirement of fat to the infant. Skimmed milk powder is important to be added to complete the sulfur amino acids. Additionally, (Motawi et al., 2011) reported that the presence of fibers could be of some necessity for more efficient and normal peristaltic movements of the gastrointestinal tract. The results in Table 6. show the gross chemical composition of the prepared formulas. It could be noticed that there were significant ($P \leq 0.05$) differences in the nutritive value of different formulas. The protein content of the tested formulas ranged from 16.02 to 19.68%. The highest value in F2 represents 140.57% RDA of the protein. (Mbogne et al., 2015) found that the germination process improves the protein content. Moreover, caloric value was highest in control (427.63) followed by formula 2 (407.21) and formula1 (396.32).

Table 6. Chemical composition (on dry weight basis %) of the prepared formula

Components %	Control	Formula 1	Formula 2
Crude protein	$16.02^{c}\pm0.28$	$18.32^{b}\pm0.09$	$19.68^{a}\pm0.52$
Fat	$9.19^{a}\pm0.09$	$6.92^{c}\pm0.03$	$8.21^{b}\pm0.06$
Ash	$2.60^{a}\pm0.01$	$2.57^{a}\pm0.02$	$2.40^{b}\pm0.01$
Crude fiber	$1.98^{c}\pm0.05$	$4.5^{b}\pm0.01$	$6.06^{a}\pm0.02$
Total Carbohydrate	$70.21^{a}\pm0.03$	$67.69^{b}\pm0.03$	$63.65^{c}\pm0.02$
Caloric value (Kcal / 100g)	427.63	396.32	407.21

Within the same column values not sharing the same letter are significantly ($p \leq 0.05$)

Amino acid content

The nutritive value of protein or mixture of proteins depended on the quantity and proportion in which these provided certain essential amino acids. Different protein and protein combinations contained the essential amino acids in varying proportions. This means that the problem of satisfying protein requirements might be solved by providing the essential amino acids in adequate amounts rather than increasing the total intake of protein (Reeds and Garlick, 2003). Data in Table 7. illustrates the amino acid content, chemical score (C.S.), protein efficiency ratio (PER) and biological value (BV) of prepared formulas. Variation of essential and nonessential amino acids of tested samples compared to FAO/WHO pattern (1991) for infant from 6 to 24 months. Control (0.96) is the highest in CS followed by formula 2 (0.92) and formula1 (0.84). Moreover, PER is used to estimate protein quality as a combination of digestibility and the essential amino acid chemical score during processing (Perez-Conesa, et al, 2002). The PER of control, formula1 and formula 2 were 2.90, 2.62 and 2.93, respectively. There was a little difference in these parameters compared to the control product (Cerelac). (Mensa-Wilmot et al., 2001; Egounlety et al., 2002 and Wadud et al., 2004) found that the range of PER of some weaning food mixture was from 2.3 to 3.1. These results agree with the above-mentioned data. Biological value (BV) of all formulas indicated that a slight difference in BV of control and formula (2). On the other hand, formula (1) represents the lowest value.

Minerals content

Table 8. illustrates the mineral content of formula and control. It could be noticed that significant difference in inerals content evaluated formula and control. Formula 2 was the highest in iron compared to Formula 1 and control. Formula and control were considered to recover the Recommended Dietary Allowance (RDA) of calcium. There was a decrease in zinc content of Formula 2 compared to Formula 1 and control. Meanwhile, Formula 1 was the lowest in phosphor compared to control and Formula 2. (Glew et al., 2006) showed that pumpkin seeds involve vitamins and significant amounts of minerals particularly phosphorus, magnesium, potassium, and iron. Moreover, (Udoh 2017) cited that the mineral content of full fat germinated pumpkin seed flour had increased compared to raw full fat pumpkin seed flour.

Table 7. Amino acid content (mg/g protein), Chemical Score (C.S.), Protein Efficiency Ratio (PER) and Biological Value (BV) of prepared formulas

Amino acid	Control	Formula 1	Formula 2	FAO/WHO Pattern
Essential amino acid (E.A.A.)				
Threonine	40.32	35.22	38.98	43
Valine	55.13	49.12	56.29	55
Leucine	71.58	65.92	73.01	93
Isoleucine	51.91	31.98	30.87	46
Tyrosine +	26.31+	28.51+	30.01+	
Phenylalanine	54.28	49.01	49.92	72
Cysteine +	17.28+	12.81+	16.93+	
Methionine	22.54	20.39	23.59	
Lysine	55.91	52.51	57.78	66
Histidine	34.06	33.26	36.82	26
Tryptophane	12.35	8.42	8.85	17
Total E.A.A.	441.67	387.15	423.05	460
C.S.	0.96	0.84	0.92	
Nonessential amino acid (N.E.A.A.)				
Aspartic acid	81.73	92.01	86.19	
Glutamic acid	126.73	131.49	159.22	
Serine	51.58	60.69	71.63	
Proline	62.60	66.98	71.09	
Glycine	39.52	41.88	44.13	
Alanine	59.60	53.26	50.01	
Arginine	52.47	55.24	62.93	
Total N.E.A.A.	474.23	501.55	545.20	
PER	2.90	2.62	2.93	
B.V.	80.45	77.52	80.75	

Table 8. Minerals content of prepared formula and comparison with daily requirements of infant (5-12) months

Minerals	Control		Formula 1		Formula 2	
	mg/100g	N.F.*	mg/100g	N.F.*	mg/100g	N.F.*
Fe	$9.98^{b}\pm0.01$	99.8	$8.08^{c}\pm0.07$	80.8	$10.9^{a}\pm0.06$	109.0
Ca	$405.2^{a}\pm2.63$	101.3	$367.1^{c}\pm3.82$	91.78	$380.0^{b}\pm3.75$	95
Zn	$4.57^{a}\pm0.01$	45.7	$4.25^{b}\pm0.02$	42.5	$3.72^{c}\pm0.01$	37.2
P	$455.2^{a}\pm5.02$	91.04	$377.6^{c}\pm3.80$	75.52	$400.6^{b}\pm4.32$	80.12

*N.F. (Nutritional fact) calculated according to N.F. = (Mineral content/RDA) x 100
RDA of infants from (6- 12) months (Fe, Ca, Zn and P are 10 – 400 - 10 and 500 mg/day).

Physical characteristics

Data presented in Table 9. show the WAI, WSI, water retention % and specific weight of the prepared formulas as well as control. Formula 2 had the lowest WAI (5.53) followed by formula 1 (5.82) and control (6.91). This means that the prepared formulas had a lower water to solids ratio than the control. This indicates that prepared formulas contained more solids than the control which was desirable for feeding. (Anderson et al., 1971) reported that a low ratio of WAI is an advantage in children because it introduces more solids per unit volume into the diet.

Moreover, there was a variation of WSI and specific weight values of prepared formulas and control. Spriet and Mercier (1979) indicated that the increase in WSI for infant formulas is a desirable characteristic. Also, Gujska and Khan (1991) showed that the content of carbohydrates and protein affected its specific weight.

Table 9. Physical characteristics of prepared formulas

Formulas	WAI (g gel/ g dry sample)	WSI %	Water retention%	Specific weight (g/100 cc)
Control	6.91	14.31	459.52	45.94
Formula 1	5.82	16.06	428.32	48.36
Formula 2	5.53	16.92	433.47	47.23

WAI = Water Absorption Index WSI = Water Solubility Index

Peroxide value of lipids during storage

Peroxide value has been taken as an index of rancidity and shelf life (Dahiya and Kapoor, 1994 and Gahlawat and Sehgal, 1994). Table 10. shows the peroxide value of prepared formulas during storage. A fair change between any two storage periods of prepared formulas at the beginning of storage. After six months of storage, Formula 2 recorded the highest peroxide value. A negligible increase in peroxide value was observed. This indicates that the prepared formulas and control remained acceptable for six months. These results agree with those reported by (Wadud et al., 2004).

Table 10. Peroxide value (ppt/Kg sample) of the prepared formulas during storage for six months at room temperature

Formulas	Zero time	Storage period (months)		
		2	4	6
Control	0.55	0.72	1.26	2.52
Formula 1	0.62	0.87	1.37	2.51
Formula 2	0.64	0.84	1.49	2.64

4. Conclusion

Sprouted pumpkin seeding flour and evaporated rice break flour were used to produce infant food, where some children suffer from malnutrition (protein deficiency), especially in children who are fed industrial milk, so the research tries to support these milks with protein and fat pumpkin seeds rich in omega-3, as the germination process improved the qualities of raw pumpkin seeding. Where there is an increase in protein, fiber, ash, and the content of amino acids and fatty acids.

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