Preparation of dried children food mixes from locally vegetable sources and estimation of their amino and fatty acids content

*1 Riyadh Shamki Ali *2Wael chassab Hmood *3Manal Abdal-wahed Alsirrag

3  collage of Agriculture ,Karbla University, Iraq
1,2 collage of Agriculture Kufa University, Iraq
manalalssirag@gmail.com

Abstract:
The study aims to prepare a complementary infants foods to meet their nutritional needs in this age period, based on local plant crops (rice, cowpea, Mung bean) and the exploitation of the abundance of these raw materials and the cost of producing dried products in the form of powders that can be retrieved with water or milk The local community in terms of providing the provision of food for the child is rich in proteins of high biological value, which contains the child's essential amino acids as well as contain those foods on the fatty acids of the child at this stage, The results showed, oleic acid content in rice, cowpea and Mung bean was ( 0.220, 0.271 ,2.567) % respectively while content of linoleic acid in rice, cowpea and Mung bean was( 0.225, 1.651 and 0.894) %, and results showed (0.224, 0.490 and 1.584) %, respectively content of linolenic acid in rice, cowpea and Mung bean , The 10 and 11 mixtures selected after cooking and addings Food fortifiers were higher than the percentage of oleic, linoleic, linolenic acid 10.38%, 7.39% and 7.68%, 1.67%, 2.01% and 2.29%, respectively.

Key words: infant’s foods, amino acid content,

Introduction :
Childhood is one of the most important stages in human life because of its role in the continuity of life and is important in the growth of development. Therefore, good nutrition for this group is very important to ensure natural growth and protect it from diseases of malnutrition and other diseases (Braun et al ; 2008), The mother's milk is the ideal food for the child at the beginning of his life. It contains all the necessary nutritional needs of the child, as well as containing immunoglobulin to protect the child from
diseases. However, some mothers cannot breastfeed their children because of insufficient milk, busy work or disease. The compensation is a necessary need where the cow milk was occupied after its transformation to resemble in its components and functions breast milk as much as possible in the forefront in the breast milk compensation, As it is possible to start giving extra food to breast milk or bottle when the baby is able to eat semi-liquid foods or some foods prepared from cooked grains and continue the development of food that is given to the child as he progresses and until weaning stage Bisla et al;2012 , The weaning period is a dangerous time for children who are in their second year of age, especially if they live in unsafe feeding and unhealthy environments, which causes them to become malnourished. This depends on the strength of the mother to feed her child, It is high while the protein content is low Neumann et al ;2012, commercially available weaning foods are expensive for the average family. Lactating mothers often rely on traditional low-nutrient weaning foods characterized by low protein and low energy density. The best way to enhance infant nutritional status is by encouraging increased use of available plant protein sources Costed as legumes in baby nutrition; this can be achieved by adding supplemental foods based on cereals and legumes Egli et al ; 2004.

Materials and methods:

Raw materials:

The Rice grain and cowpea and Mung bean were obtained from a local market (karbala) , washed sorted and oven dried. The seeds were milled in attrition mill and sieved through 0.4mm wire mesh. It was packed in plastic containers sealed with aluminum foil and stored at room temperature prior to analyses (Egli et al ;2002).

Selecting raw materials ratios mixtures:

Prepared dried food manufacturing mix 18 to study use different mixing ratios of rice and cowpeas Mung bean to give one mixture 20% protein. Having adopted in preparing these mixtures the contribution of each component of the basic material of protein ratios (50, 40, 30, 20 and 10)% of the total protein to the mix, these percentages correspond to the three basic materials so that 100% of the total protein to the mix. Table (1) various mixtures that have been selected and prepared.

Table (1) Mixtures used in manufacturing

| mixture | Total weight of the mixture (g) | Mung bean flour | Cowpeas flour | Rice flour |
|---------|--------------------------------|----------------|--------------|-----------|
|         | Quantit y (g) | Contributing to the total protein (%) | Quantit y (g) | Contributing to the total protein (%) | Quantit y (g) | Contributing to the total protein (%) |
| 1       | 175.5          | 37              | 40           | 12        | 10         | 126.5       | 50          |
| 2       | 178.4          | 27.9            | 30           | 24        | 20         | 126.5       | 50          |
| 3       | 181.1          | 18.6            | 30           | 36        | 30         | 126.5       | 50          |
Manufacturing Processes:

One of the previous mixtures was randomly chosen for manufacturing operations to reach the best manufacturing conditions that can be applied to all mixtures. The method of preparing children's food has been followed (Buffa, 1971).

Manufacturing Method:

The mixture was cooked in a stainless steel container with continuous stirring and then placed in stainless steel trays and in a thin layer that can be dried in the oven at 50 °C for 20 hours. And then grinding the dried food using a local mill of the type (Sokany) and then exposing the powder to the temperature of 85 °C in the oven for 4 minutes to prevent the occurrence of microbial contamination, and finally put the powder in the bags of polyethylene and kept in the refrigerator at a temperature of 4-5 °C until sensory evaluation (Tarek, 2002).

Sensory assessment before modification:

Sensory evaluation was carried out according to the method followed by Nelson and Trout (1964) with some modification used for prepared and dried food mixtures after retrieving them with water so that the recovery rate was 1 powder: 2.5 water (weight / volume). The assessment was conducted by introducing the general acceptance rating in the evaluation according to the sensory assessment form table (Scriver et al.; 2001).

Statically analysis:

The CBD was used to analyze the results of the sensory evaluation experiment of the prepared food mixes while the full CRD was used to analyze the chemical content evidence of the selected mixtures. The differences between the averages were compared with the Duncan Multiplication
test at 5% probability level (SAS; 1989). The data were analyzed using the GenStat V12 software and CRD was used to obtain the best mixtures.

Add Enhancers to your favorite food mixtures:

As a result of the sensory evaluation, the best nutritional mixtures were selected, which received the highest ratings for improvement, which included the addition of the following:

The sugar was added to the selected food by 3, 5, 7 and 10% of the weight of the dried food, and was added in a step after grinding the food and get the powder before exposure to 85 °C.

Flavored:

Vanilla was used as a flavor, 3, 7 and 10% of the dried food. It was added in a step after grinding the food and obtaining the powder before exposing it to 85 °C.

Skim Milk:

The dried milk was used as the Niddo mark available in the local markets (karbala) and by 5% of the weight of the dried food. The milk was added in a step after grinding the food and obtaining the powder before exposing it to 85 °C. After fixing the proportion of sugar and vanilla.

Sensory assessment after modification:

Sensory evaluation was performed on the improved food mixture and for each stage of addition of the enhancers. The dried mixture was retrieved with water (1: 2.5 w/v). The evaluation was given according to the method followed by (Nelson, and Trout, 1964)) Instead of the packaging.

Amino acid evaluation:

The analysis was carried out in the Environment and Water Laboratories / Ministry of Science and Technology using the Korean Amino Acid Analyzer. Amino acids (Lysine, Threonine, Methionine, Leucine, Isoleucine, Valine, Phenylalanine, Histidine were estimated based on the method provided by (Scriver et al ;2001) and according to the conditions attached in the table (3), Calculation of the amino acid ratio by the retention time and the relative area of the area.

Determination of fatty acids:

Fatty acid oleic, linoleic, linolenic, palmitic and stearic ) content of the mixtures were determinate using gas-liquid chromatography(GC – 2010, SE- 30 , japan). The lipid classes were separated by thin layer chromatography on silica gel G 40 using hexane/ ethylether/acetic acid (76/22/2/v/v/v) as developing solvent with float rate 100 Kpa (Donkeun et al ;2000).
Results and Discussion:

The percentages of oleic, linoleic, linolenic, palmitic and stearic fatty acids in primary raw materials (rice, cowpea and Mung bean) were 0.220, 0.225, 0.224, 0.262 and 0.136% respectively, and cowpea 0.27, 1.65, 0.49, 0.43 and 0.46% respectively. Respectively. In the Mung bean, the ratios were 2.56, 0.89, 1.58, 1.30 and 1.78%, respectively. Because of the mixing of these raw materials in different percentages obtained balanced fatty acids. The linoleic acid is a fatty acid essential and imitates the process of development and increase of the child as it can be transmuted in the body of the child to acid Arachidonic( IOM et al ;2012).

| Fatty acid | Mung bean | Cowpeas | Rice |
|------------|-----------|---------|------|
| Oleic      | 2.567     | 0.271   | 0.220|
| Linoleic   | 0.894     | 1.651   | 0.225|
| Linoleiniec| 1.584     | 0.490   | 0.224|
| Palmitic   | 1.300     | 0.432   | 0.262|
| Stearic    | 1.786     | 0.463   | 0.136|

The content of primary raw materials of amino acids:

It is noted from the table (3) that rice is free of lysine amino acid as well as free of cowpea and Mung bean of methionine and cysteine, as well as the absence of raw materials of some amino acids such as tryptophan, and these percentages can be low if not shown by analysis. The content of the basic amino acids of rice was higher than that found by( Mahmoud and Anany, 2014) when manufacturing complementary baby food from rice, beans, sweet potato flour and bean oil.

| Amino acids | Mung bean | Cowpeas | Rice |
|-------------|-----------|---------|------|
| Lysine      | 187       | 11.2    | -    |
| Threonine   | 16.6      | 85.6    | 26.4 |
| Methionine  | -         | -       | 118.8|
| Leucine     | 94.9      | 120     | 49.1 |
| Isoleucine  | 139       | 26.4    | 36.3 |
| Valine      | 24.75     | 16.5    | 9.1  |
| Phenylalanine| 44.1     | 61.6    | 12.8 |
| Histidine   | 65.6      | 23.5    | 32.1 |
| Glycine     | 54.12     | 83.3    | 29.37|
| Arginine    | 31.35     | 111     | 4.38 |
| Alanine     | 55.3      | 171     | 11.8 |
| Tyrosine    | 77.9      | 177     | 18.4 |
Formation of various mixtures of primary raw materials:

Result showed that 18 mixtures of different food mixtures consisting of rice, cowpea and Mung bean depending on the proportion of the participation of each substance in the total protein content in the mixture, amounting to 20%, which in turn depends on the proportion of protein percent in each material so that the three materials together about 20% protein and this does not Mean that the quantity of the mixture of one of the three basic materials 100 grams, the basic materials were mixed and prepared for processing, followed by the procedure of sensory evaluation and statistical analysis to choose the best mixtures prepared in terms of sensory characteristics, table (4) shows the amount of basic materials in grams involved in the composition of mixtures Foods consisting of rice, cowpea and Mung bean.

Table (4) Quantity of basic materials per gram for the incorporation of dried and canned food assemblies

| Mix number | Total Mix Weight (g) | Weight of Mung bean flour (g) | Weight of Cowpeas flour (g) | Weight of rice flour (g) |
|------------|----------------------|--------------------------------|-----------------------------|-------------------------|
| 1          | 174.5                | 37                             | 12                          | 126.5                   |
| 2          | 178.4                | 27.9                           | 24                          | 126.5                   |
| 3          | 181.1                | 18.6                           | 36                          | 126.5                   |
| 4          | 167                  | 18                             | 48                          | 101                     |
| 5          | 164                  | 27                             | 36                          | 101                     |
| 6          | 159.5                | 46.5                           | 12                          | 101                     |
| 7          | 170                  | 9                              | 60                          | 101                     |
| 8          | 154.5                | 18.6                           | 60                          | 75.9                    |
| 9          | 138.5                | 27.9                           | 60                          | 50.6                    |
| 10         | 135.6                | 37                             | 48                          | 50.6                    |
| 11         | 151.8                | 27.9                           | 48                          | 75.9                    |
| 12         | 183.5                | 9                              | 48                          | 126.5                   |
| 13         | 119.8                | 46.5                           | 48                          | 25.3                    |
Sensory evaluation of processed food mixtures:

Table (5) shows the results of the sensory evaluation of the dried food mixes. The sensory evaluation of the prepared and dried food mixtures was carried out after retrieving the water with a recovery rate of 1: 2.5 water (w / v). The ten teachers and postgraduate students in the Department of Food Science / College of Agriculture / University of Kufa. The results of the sensory evaluation were analyzed using sector design using Duncan test and 5% probability of obtaining the best mix. The result was significant differences between the food mixes used. The food combinations (10) and (11) were chosen for the highest scores in sensory evaluation.

Table (5) The average of the final sensory evaluation of dried food mixes

| Mix no | All Acceptance | Texture | Color | Test | odor |
|--------|----------------|---------|-------|------|------|
| 1      | 64.60cde       | 64.40cde| 74.80a| 66.40cdef | 72.80 abc |
| 2      | 55.80g         | 56.40f  | 55.60e| 56.40j  | 59.00 h  |
| 3      | 66.20bcd       | 65.80cde| 65.40bcd | 72.80abc | 66.60 cdef |
| 4      | 65.00cde       | 62.20def| 63.80d | 63.20fg  | 63.80efgh |
| 5      | 58.40fg        | 60.80ef | 60.60de| 61.00gij | 61.20 gh |
| 6      | 68.40abc       | 68.40bcd| 75.00a | 68.40defg | 75.00ab |
| 7      | 65.80cde       | 64.40cde| 65.00bcd | 65.80efgh | 65.20 defg |
| 8      | 65.00cde       | 67.20bcd| 64.40cd | 66.00defg | 66.60 cd |
| 9      | 74.60a         | 69.20bc | 70.60abc| 69.00bcd | 69.40 bc |
| 10     | 74.40a         | 72.80 ab| 71.60ab | 73.40ab  | 73.20ab |
| 11     | 74.40a         | 77.40a  | 74.00a | 78.20a   | 76.40 a  |
| 12     | 59.80efg       | 58.00f  | 58.80de| 59.00ij  | 60.80 gh |
| 13     | 60.80efg       | 64.20cde| 61.60de| 62.40fg  | 62.40 fgh |
| 14     | 72.20ab        | 70.40bc | 75.60a | 68.60bcd | 71.00abc |
| 15     | 72.40ab        | 70.20bc | 71.40ab | 70.80bcd | 69.40 bc |
| 16     | 67.60bcd       | 67.40bcd| 70.80abc| 68.60bc  | 68.60 bc |
| 17     | 72.40ab        | 69.40bc | 71.60ab| 72.60abc | 74.00 ab |
| 18     | 61.20def       | 62.40def| 60.60de| 62.20ghij| 62.20 gh |

* Means with similar letters mean that there are no significant differences between them at the 5%
Additives added to favorite chosen food mixes:

Sugars:

Table (6) shows the addition of sugar (3, 5, 7 and 10%) of the weight of the dried food as it improved the degree of food acceptance. The average final evaluation score of 3 and 5% was significantly different from the average final rating of 7 and 10%. It was chosen by the residents, using sector design and Duncan testing at a 5% probability level to obtain the best ratio of additives. Therefore, the percentage of addition of sugar was chosen as 7% because it gives a good taste as well as its economic aspects compared to 10%, and this percentage falls within the limits indicated by a number of researchers (Szulc, 2016, Oyeyinka, 2016).

Table (6): The average final evaluation of dried food mixes after the addition of sugar

| Mix no | Sugar content (%) |
|--------|-------------------|
|        | 10    | 7    | 5    | 3    |
| 10     | 74.8 d | 74 c | 65b  | 62 a |
| 11     | 75 d   | c 74 | 64 b | 61 a |

Flavored vanillin:

Table (7) shows the addition of vanillin by 3, 7 and 10% of the weight of the dried food after the sugar content. The average final rating of dried food after the addition of vanillin was 3% and 7%, and after water recovery of 1: 2.5 (w / v) was significantly different from the average final rating of 10%, which was chosen by the residents. These percentages fall within the limits referred to by the draft Iraqi Standard Standards issued by the Central Organization for Standardization and Quality Control (1986). After stabilizing the vanillin additive, the dried food was recovered by using the dried milk by 5% of the food weight and then the food was dissolved with water by 1: 2.5 (weight / volume). The mean final evaluation score was significantly different from the average final assessment of the water-free and milk-free food-digested batch. (Sherifah, and Onilude, 2009).

Table (7) The average grade of final evaluation of dried food mixes after the addition of vanillin

| Mix no | skin milk addition 5% | Addition of vanillin (%) |
|--------|------------------------|--------------------------|
|        | 10    | 7    | 3    |
| 10     | d     | 82.20| 77 c  | 74 b  | a  71 |
| 11     | 80.80 e | 78 c | 75 b  | 72 a  |
Fatty acid content:

In Table (8) results shows the content of total fatty acids in the mixtures of prepared foods. In general, the fatty acid content is observed in the selected food mixes of oleic, linoleic, linolenic and stearic. The high percentage of unsaturated fatty acids in the prepared mixtures, as the ratios of fatty acids, oleic, linoleic and linoleic between 10.38 - 1.67% and 2.01 - 7.39% and 7.68 - 2.29%, respectively, and the latter are the main fatty acids that must be available in food especially in child food. (Crimi et al.; 2014), The increase in these percentages may be due to the addition of milk by 5% to the two blended mixtures as well as to the mixing ratios used for the raw materials. A balancing process of fatty acids is achieved. The percentages of saturated fatty acids (palmitic and stearic) for the dried food mix reached 3.55% Respectively, while the dried food mix (Donkeun et al; 2000) was 0.38% and 2.42%, respectively. These results were lower than those found in the mother's milk. The percentages of these acids in the mother's milk were 20.50% and 9.00% respectively. These saturated fatty acids are a good source of energy as well as important for the body's functions. The palmitic and stearic acid have an important role in improving the properties Food(IOM;2011) , The ratio of fatty and palmitic fatty acids was less than the range mentioned by (Oveisi et al ;2006) when analysis of fatty acids in 20 types of infant formula, with a range of 19% - 27% and 5% -10%.

The percentage of monounsaturated polyunsaturated fatty acids in the dried food mix (Scriver et al ;2001) was 10.38% and in the dried mixture (Donkeun et al ;2000) was 1.67%, which is lower than that found in breast milk which reached 37.60%

The percentages of polyunsaturated fatty acids (LNA) and linolenic acid (Scriver et al ;2001) were 7.39% and 7.68% respectively. In the dried mixture (Donkeun et al ;2000), it was 2.01% and 2.29% respectively, Was found in breast milk with 12.10% ((IOM ;2011). For linolenic acid, the ratio was higher than that found in breast milk (0.1%). These results were lower than those found by (Onabanjo et al ;2008) which ranged from 270.6 - 285.9% to linoleic acid, and 12.5 to 13.3% to linolenic acid. Linoleic acid is one of the fatty acids that humans need and can not manufacture in the human body. It is considered essential in the diet as it is an introduction to aragonic acid. It is one of the pillars of eucosanoid production, which is involved in the regulation of gene expression. Linoleic acid is a structural component of cell membranes. It is important in sending signals in cells and the recommended amount of linoleic acid ranging from 1.0 to 2.4 g / Day (Lanzmann , 2001)). The results showed that fatty acid ratios in the prepared food mixes were similar to those found in (Elmadfà and Majchrzak ;2000) when they studied fatty acids for a range of baby food products available in the Australian market, and less than what was found in seawater (Elmadfà, and Majchrzak, , 2000) ) Balmteic and Stearic between 19.87 - 19.59% and 7.90 - 7.40%, respectively. And less than what ( Mahmoud, and Anany, 2014) found when analyzing fatty acids for prepared food mixes.
Table (8) Fatty acid content of dried food prepared mixtures with additives

| Fatty acid   | Mix no 11 | Mix no 10 |
|--------------|-----------|-----------|
| Oleic        | 1.76      | 10.38     |
| Linoleic     | 2.01      | 7.39      |
| Linoleiniec  | 2.29      | 7.68      |
| Palmitic     | 0.38      | 3.55      |
| Stearic      | 2.24      | 5.40      |

Amino acid content:

Table (9) results shows the content of mixtures prepared from essential amino acids compared to those found in breast milk to meet the child's needs of amino acids (WHO, 2007). The supplements show amino acid packages for raw materials and prepared food mixtures.

The amino acid concentration of lysine, methionine and leucine in the food mix was 10, 187, 16.7 and 149 mg / g protein, respectively, while the food mix 11 was 49.38, 24.5 and 165 mg / g protein, respectively.

(Liang, 2011) showed an increase in essential amino acids in mixtures made from grain flour and pulses. The mixtures of staple foods are highly nutritious and have a high protein efficiency, especially when milk is used (Phongthai et al ;2017) and higher than what was found by al-Sulaimi (1994) in the manufacture of baby foods consisting of wheat flour, concentrated soybean protein and powdered milk in the preparation of auxiliary infant food. Consistent with what (٢٢) of increased acidity (Phongthai et al ;2017) when using germination and fermentation techniques for some sources of cereals and pulses in the preparation of baby food.

Table (9) Content of mixtures prepared from essential amino acids

| Amino acid g protein /mg | Composition of mother's milk from amino acids | Mix no 11 | Mix no 10 |
|--------------------------|----------------------------------------------|-----------|-----------|
| Lysine                   | 69                                           | 49.38     | 187       |
| Threonine                | 44                                           | 15.5      | 138       |
| Methionine               | 16                                           | 24.5      | 16.7      |
| Leucine                  | 96                                           | 165       | 149       |
| Isoleucine               | 55                                           | 123       | 24.0      |
| Valine                   | 55                                           | 76.56     | 39.93     |
| Phenylalanine            | 42                                           | 27.56     | 18.9      |
| Histidine                | 21                                           | 17.69     | 86.7      |
Conclusion

The functional foods are one of the most important foods that have been used in recent times and are of great importance in enriching the body with the basic components. The children category is considered to be a sensitive category. This study was aims to prepare food mixtures as Functional foods with a high protein content that enhancing growth and build of body tissues these foods were generally well tolerated by residents.

References:

[1] Braun, J.V. and M. Rule, M., Gulati, A. (2008) Accelerating progress towards reducing Child Malnutrition in India. A concept for action. Sustainable solutions for ending hunger and poverty, Washington, DC: International Food Policy Research Institute (IFPRI), 1-8.

[2] Bisla G Archana , and Pareek, S. (2012). Development of nutrient dense supplementary products for children by using locally available cereals, soy flour, bengal gram leaves and cow pea leaves, Asian J. Plant Sci. Res., 2 (4):396-402

[3] Neumann, C., Harris, D. M., and Rogers, L. M. (2002). Contribution of animal source foods in improving diet quality and function in children in the developing world. Nutrition Research, 22(1-2), 193-220.

[4] Egli, I., Davidsson, L., Zeder, C., Walczyk, T., Hurrell, R. (2004). Dephytinization of a complementary foods based on wheat and soy increases zinc, but not copper apparent absorption in adults. J. Nutr., 134, 1077–80

[5] Egli, I., Davidsson, L., Juillerat, M.A, Barclay, D., Hurrell, R. (2002). The influence of soaking and germination on the phytase activity and phytic acid content of grains and seeds potentially useful for complementary feeding. J. Food Sci., 67, 3484–8.

[6] Buffa, A. (1971). Food technology and development. special. UNICEF Report. UNICEF, Paris, France.

[7] Tarek, A. E. (2002). Nutritional composition and antinutritional factors of chickpeas (Cicer arietinum L.) undergoing different cooking methods and germination. 57, 83-97.

[8] Nelson, J. A. and Trout, G. M. (1964). Judging dairy products. The Olsen Puplishing Co., Milwaukkee, Wis., U. S. A.

[9] SAS 1989 SAS/STAT users Guide. Statistics Ed. N.C.

[10] Scriver CR, Beaudet AL, Valle D, Sly WS, Childs B, Kinzler KW, Vogelstein B, eds. (2001). The Metabolic and Molecular Bases of Inherited Disease. 8th ed. New York, NY: McGraw-Hill, Inc; 2001;1665-2105.

[11] Donkeun, P, Kenneth, G.D.A., Stermitz, F.R. Maga, J.A. (2000). Chemical composition and physical characteristics of unpopped popcorn hybrids. J. Food Composition Analy., 13(6), 921-934.
[12] Institute of Medicine (IOM). (2011). Dietary reference intakes: Recommended Dietary Allowances and Adequate Intakes, Elements, Total Water and Macronutrients. Food and Nutrition Board, Institute of Medicine, National Academies.

[13] Mahmoud, A. H., and Anany, A. M. E. (2014). Nutritional and sensory evaluation of a complementary food formulated from rice, faba beans, sweet potato flour, and peanut oil. Food and nutrition bulletin, 35(4), 403-413.

[14] Szulc., N. (2016). Sugar and food additives as apart of food industry, Bachelor, Thesis Centria University of applied science industria management.

[15] Oyeyinka, A.T. (2016). Nutritional, Sensory and Functional Prosperities of A Bambara Groundnut Compliantly food., Thesis, University of KwaZulu-Natal, Pietermaritzburg.

[16] Sherifah, M. Wakil, A. Onilude, A. (2009) Microbiological and chemical changes during production of malted and fermented cereal-legumes weaning food

[17] Crimi, E., Sica, V., Williams-Ignarro, S., Arthur, H.Z., Louis, S., Ignarro, J., Napoli, C. (2006). The role of oxidative stress in adult critical care, Free Radical Biology & Medicine 40 398 – 406 399.

[18] Oveisi, M. R.; Sadeghi, N.; Hajimahmoodi, M.; Jannat, B.; Behfar, A. and Sobhani, H. (2006). Quantitative determination of fatty acids in infant formula by gas chromatography without derivatization., Acta. Med. Iranic., 44 (4) : 225-229.

[19] Onabanjo, O.O., C.R.B. Oguntona, B.M. Dixon, I.O. Olayiwola, E.B. Oguntona and A.G.O. Dixon. (2008). Nutritional evaluation of four optimized cassava-based complementary foods. Afr. J. Food Sci. 2:136-142.

[20] Lanzmann, P.D. (2001). Alpha-linolenic acid and cardiovascular disease. J Nutr Health Aging 2001;5:179-83.

[21] Elmadfa, I. and Majchrzak, D. (2000). Fatty acid profile in baby food products. Eur. J. Lipid Sci. Techn., 270-275.

[22] Mahmoud, A. H., and Anany, A. M. E. (2014). Nutritional and sensory evaluation of a complementary food formulated from rice, faba beans, sweet potato flour, and peanut oil. Food and nutrition bulletin, 35(4), 403-413.

[23] World Health and Organization (WHO) (2007). Protein and Amino acid Requirement in Human Nutrition. WHO Technical Report Series 935 : 1-265.

[24] Liang, Yu (2011). Extrusion processing of protein rich food formulation, A thesis submitted to McGill University in partial fulfillment of the requirements of the degree of Doctor of Philosophy

[25] Phongthai, S., Homthawornchoo, W. and Rawdkuen, S. (2017) Preparation, properties and application of rice bran protein: A review, IFRJ 24(1): 25-34