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Development of Nutritional Value Added Wheat Based Weaning Mixes

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Abstract
First 1000 days are very crucial for the physical & mental development of an infant. Right nutrition is of utmost importance for this age group. With this view, **wheat based** value added weaning mixes were developed & standardized. The mixes were scrutinized for their acceptability, physic-chemical characteristics, dietetic value and shelf life. Four types of weaning mixes were developed using wheat + soyabean / moth bean + pumpkin / papaya powder termed as WM 1, WM 2, WM 3 & WM 4. Malting, roasting and oven drying methods were used to prepare weaning mixtures in powder form.

The mean score for overall acceptability of developed wheat based weaning mixes ranged from 7.99 to 8.3. Acceptability by sensory evaluation & plate waste weighment method was more for mothbean based weaning mixes as compared to soyabean based weaning mixes. Physic-chemical characteristics were analyzed for yield, water retention capacity & swelling index that was found more for soyabean based weaning mixes. Shelf life of different weaning mixes was compared & found significantly more in mothbean based (WM1 & WM 2). Soyabean based weaning mix (W4) was found to have maximum water retention capacity that showed lower shelf life in comparison to other mixes. Nutritional value was calculated for all weaning mixes in which WM3 & WM 4 (soyabean based) samples showed maximum nutritive value as compared to other samples ($p<0.01$).

It was concluded that developed weaning mixes were nutritious and found to be equally acceptable as fresh after 3 months of the storage period.

Keywords
Wheat based weaning mixes, nutritional evaluation, and infants' nutrition

Introduction
Nutrition is an important phenomenon for each and every stage of life. It is most important for the period of infancy to childhood. A healthy child is happiness of the parents, pride of the community, thrill of a society and hope of a nation. Hence sound health of children is critical to every nation (Bulusu *et al*., 2007)

The word 'wean' is derivative of word 'weaning' which means to acclimatize to as a child to take food. The American academy of pediatrics (AAP) recommends exclusive breast milk feeding up to first 6 months of infancy. After six months a combination of breast milk and solid foods should be fed to the infant till one year of life.

Lack of proper nutrition is one of the major issue in the health of infants and young kids in most of the developing countries. The abundance of malnutrition in the children in India is

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among the highest in the world (UNICEF,1998). In our country the infant are mostly dependant on breast milk alone during infancy. The health and growth rate of the children are below par during this period. After six months of age only having the breast milk alone is not recommended to provide adequate quantum of nutrients required for the growth. In fact, the diminishing amount of mother's feed cannot suffice the requirement of calories and protein of the growing children. Milk is a inadequate source of vitamin C and supplementing the same with fruit juices should be given at least from six months onwards (Agostoni *et al*., 2007).

Pulses and cereals are the major components of our diets. They are acclaimed contributors of nutrients and vitamins in the diet of majority of the population in the developing countries. The use of different methods of processing improves the nutritional composition of available food items. Roasting and malting of grains are food processing methods used everywhere in our country. These processes are proven methods not only in increasing the digestion but also the nutritional content of the grains. They catapult the nutrients in the grains by affecting various physico-chemical modifications in the diet (Matz, 1991).The germination increases its dietary contents of the pulses. After germination the pulses are found be enriched in vitamin C content, other vitamins along with folic acid. The anti-nutritional factors such as tannins and phytates, which adversely affect the bioavailability of nutrients breakdown during germination, thus germination improves the available of nutrient contents (Dogra *et. al*., 2004; Singh *et al*., 2015)

Many mothers rely on rice or mashed fruits which do not supply all the required nutrition of a growing infant in the stipulated proportion. To disrupt the cereal based nutrition to a growing infant it is prudent to feed a scientifically prepared weaning mix of pulses, fruits and vegetables in order to reduce the protein energy malnutrition in our country. Thus a lot of preparations based on pulses and coupled with processing methods such as malting and roasting are essential to increase the protein requirements of weaning food. Further addition of oil seeds, milk powder, sugar, fruits and vegetables to a cereal-pulse combination may improve nutritional quality of the product. Since the oilseeds, milk powder and sugar are good source of energy, protein and minerals which provide dense quality of nutrients similar to fruits and vegetables as good source of vitamin & minerals.

Supplementary feeding has been recognized to be one of the effective short-term programme for attacking the problem of malnutrition or its roots providing relief to the most effected vulnerable group. Supplementary food based on blend cereals, oilseeds meals and legumes fortified with vitamins and minerals have been developed by the several workers.

Aims & Objectives

Aim of the present study was to improve the infants' health through scientific development of weaning mixes with the following objective -

1. To assess acceptability of different types of weaning mixes
2. To study physico- chemical characteristics of developed weaning mixes
3. To analyze nutritive profile of different types of weaning mixes
4. To study the shelf-life of developed weaning mixes

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Research Methodology

The present study was undertaken to develop the value-added weaning mixes for infants aged 6-12 months. These weaning mixes were based on wheat, soyabean, moth bean, milk powder, sugar, fruits & vegetables and present study was performed to find out their acceptability, physico- chemical characteristics, nutritive value & shelf life
Methodology has been divided into following sub heads-

1. Procurement of materials
2. Processing of raw materials
3. Development of different types of weaning mixes
4. Evaluation of acceptability of weaning mixes
   a. Through sensory evaluation
   b. Through plate waste method
5. Physico- chemical properties of weaning mixes (Water retention capacity, swelling index & yield)
6. Nutritive value of developed weaning mixes
7. Shelf life of weaning mixes
8. Statistical analysis

1. **Procurement of Raw materials**
   Wheat, moth bean, soya bean, pumpkin, papaya, milk powder and sugar bought from the market in a single lot to avoid varietal variances.

2. **Processing of Raw materials**
   The seeds (wheat, mothbeans & soyabeans) after washing were subjected to the processes of soaking, germination, drying & roasting as shown in diagram 1

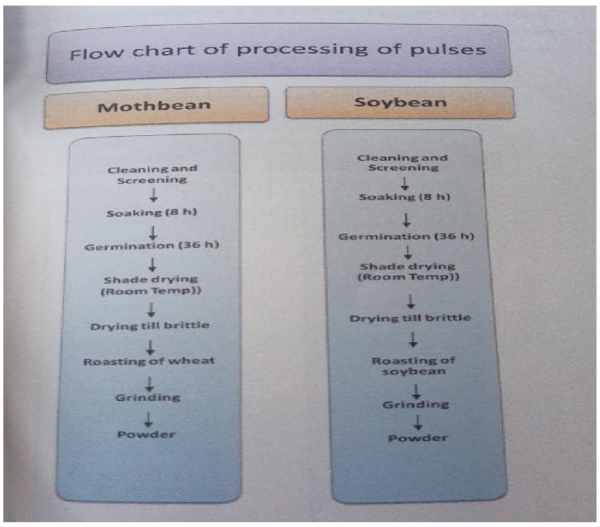

Image1: Processing of seeds

Processing of papaya & pumpkin was done as shown in following diagram 2.

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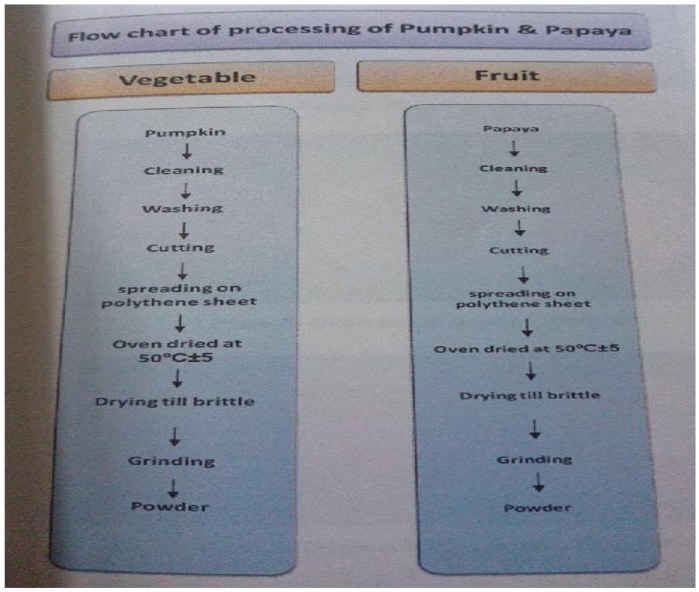

Image 2: Processing of pumpkin & papaya

Image 3: Oven dried pumpkin powder

Image 4: Oven dried papaya powder

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3. **Development of different types of weaning mixes**

WM 1	WM 2	WM 3	WM 4	AMOUNT
Wheat	Wheat	Wheat	Wheat	50 g
Mothbean	Mothbean	Soyabean	Soyabean	25 g
Papaya powder	Pumpkin powder	Papaya powder	Pumpkin powder	25 g
Milk powder	Milk powder	Milk powder	Milk powder	25 g
Sugar	Sugar	Sugar	Sugar	25 g

Table 1: Standard composition of different types of weaning mixes

Cost of developed weaning mixes was also calculated on the basis of raw products which ranged between 5.80 - 6.15 INR per 100 g.

Method of preparation of weaning mixes was as follows -

- Germinated cereal and pulses were roasted and ground to the powder separately
- Mixed all the ingredients together in the given proportion
- Stored in air tight container
- Added boiled and cooled water at the timing of serving

4. Evaluation of acceptability of weaning mixes

a. Through sensory evaluation

The developed weaning mixes were provided to the panel members in similar bottles with codes to differentiate for evaluation. SOP's were observed to provide the conducive assessment for the sensory evaluation of panel members. Nine-pointer Hedonic ranking scale was provided to the judges for scoring as suggested by Ranganna (1986).

b. Through plate waste method

Developed weaning mixes were served to infants aged 6-12 months of Ratanpura village of Sangaria city. An average of 20 g of each weaning mix was served to 10 infants in the duration of one hour in the morning time and no other feed given to them in this duration & consumption was calculation as following formula -

$$\text{Consumption} = \frac{\text{Food served (g)} - \text{Plate waste (g)}}{\text{Food served (g)}}$$

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5. Physical & chemical properties

Physical & chemical characteristics of yield, water retention capacity & swelling index were analyzed of all weaning mixes.

a. Yield - The weights of the weaning mixes were taken and the yield was calculated using the formula as suggested by Negi (2003)

$$\text{Yield \%} = \frac{\text{Weight of the mix}}{\text{Weight of the raw material}}$$

b. Water retention capacity

It was calculated by the procedure prepared by McConnell et al. (1974). Two grams of the sample was weighed and then soaked in 20 ml. of distilled water for 24 hrs. Weight of the soaked sample were centrifuged at 3000 rpm for 20 minutes.

$$\text{Water Retention (ml/g)} = \frac{\text{Water Retained (ml)}}{\text{Weight of sample}}$$

Water Retained = vol. of water added (20ml) – vol. of water obtained after centrifugation

c. Swelling index (ml/g) = $\frac{\text{Change in volume (ml)}}{\text{Amount of sample (g)}}$

6. Nutritive Value of developed weaning mixes

Nutritive value of developed weaning mixes was calculated using Indian Food Composition Tables (2017). Nutritive value for fats, carbohydrates, protein, energy, iron, calcium & vitamin C was calculated for the quantity used for the ingredients in different types of weaning mixes.

7. Shelf life of acceptable weaning mixes

To check the shelf life of developed weaning mixes, which are accepted by the infants were stored at room temperature and at 70% relative humidity in poly bags for 3 months. Their acceptability was analyzed again after 3 months (90 days) -

a. Through sensory evaluation - Stored weaning mixes were tested for acceptability using 9 point hedonic scale measuring their organoleptic properties by a panel of judges (Srilakshmi, 2017) at the interval of 30 days up to 90 days.

b. Through plate waste method -

$$\text{Consumption} = \frac{\text{Food served (g)} - \text{plate waste (g)}}{\text{Food served (g)}}$$

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8. Statistical analysis

1.1. Standard deviation

$$S.D. = \frac{\sqrt{\{X2 - (\{X)2}}{N}$$

2. Standard error of mean

$$SEM = \sqrt{(EMS)/nS}$$

Results & Discussion

The finding of the present study was computed preciously and presented below along with the relevant justifications in the following 4 heads.

1. Organoleptic acceptability of the developed weaning mixes
   a. By sensory evaluation method
   b. By weighment of plate waste

2. Physico- chemical properties of weaning mixes
   a. Yield
   b. Water retention capacity
   c. Swelling index

3. Nutritive value of different types of weaning mixes

4. Shelf life of acceptable weaning mixes

1. Organoleptic acceptability

a. By sensory evaluation method

Weaning mixtures were developed using different combinations and evaluated for their acceptability. Four weaning mixtures were evaluated on a 9 pointer Hedonic scale. Individual scores were given to the sensory characteristics of the weaning mixes for colour, form, odour, feel, flavor & on the whole acceptability as shown in table 2.

S.No	Weaning Mixes	Mean score of sensory characteristics on nine point scale					
		Colour	Form	Odour	Feel	Flavour	Acceptability
1	W.M. 1	8.3 ±0.4	8.2±0.458	8.4±0.3	8.3±0.458	8.5±0.6	8.3±0.6
2	W.M. 2	8.5±0.4	8.2±0.538	8.3±0.63	8.4±0.4	8.2±0.6	8.3±0.538
3	W.M. 3	7.9±0.53	7.7±0.781	8.1±0.53	8.1±0.7	7.7±0.64	7.9±0.748

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4	W.M. 4	7.7±0.45	8.0±0.632	8.3±0.45	8.1±0.53	8.0±0.44	8.0±0.632

Table 2: Sensory evaluation scores for different types of weaning mixes

The above table 2 is showing highest scores for colour and form for WM 2 and highest scores for odour & taste for WM 1 although the difference in sensory attributes was not statistically significant and all weaning mixes were equally acceptable by the panel with overall acceptability score ranging between 7.9 - 8.3. Fabiyi (2006) studied about the consumption of soya based products. It was concluded in their study that consumption of soya products reduced risk of heart disease, osteoporosis, menopausal symptoms and cancer. The milling process of soyabean influences the palatability and digestibility. Processing also provided better protein as well as texture also. After observing, health benefits of soyabean, it is essential to make people aware regarding this and enhance its intake.

b. Evaluation of acceptability by weighment of plate waste

Consumption of Weaning Mixes		
S. No.	**Weaning Mixes**	**Means score of consumption**
1	WM 1	16 g (100%)
2	WM 2	20 g (100%)
3	WM 3	10 g (100%)
4	WM 4	10 g (100%)

Table 3: Consumption of weaning mixes by plate waste method

As consumption of weaning mixes was assessed by plate waste method in which 20 g sample was served to infants between 6 - 12 months of age. It was found that WM 2 i.e. mothbean papaya based mix was consumed 100 %, while soyabean based weaning mixes were consumed 50% only which was statistically significant ($p<0.01$). Dutta & Sharma (2020) emphasized in their study that initiation of early complementary feeding should be analyzed for its causes and guidelines should be laid down to introduce balanced nutrition throughout infancy and childhood. Due to un- affordability of commercially prepared expensive infant foods, emphasis should be given to homemade complementary feeding formulae prepared using traditional processing method. These are nutritious as well as inexpensive also.

2. Physico-chemical properties of weaning mixes

a. Yield (%) of raw materials

S.No.	**Raw material**	**Treatment**	**Yield**	**SD**
1	Wheat	Germinated and shade dry	97.81	±0.19
2	Mothbean	Germinated and shade dry	98.03	±0.36
3	Soyabean	Germinated and shade dry	97.70	±0.21
4	Papaya	Oven dried	15.05	±0.11
5	Pumpkin	Oven dried	13.40	± 0.24

Table 4: Yield of different ingredients used in weaning mixes after processing.

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Table 4 is showing yield of different ingredients used in weaning mixes after processing. It was found that seeds like wheat, mothbean & soyabean showed about 97 - 98% yield by weight after processing while fruit (papaya) and vegetable (pumpkin) presented a yield of around 14% that was 86% lesser as compared to their raw weight. It may be attributed to the high moisture content of fresh fruits & vegetables in comparison to dry seeds.

b. Water Retention Capacity (ml/g) of weaning mixes

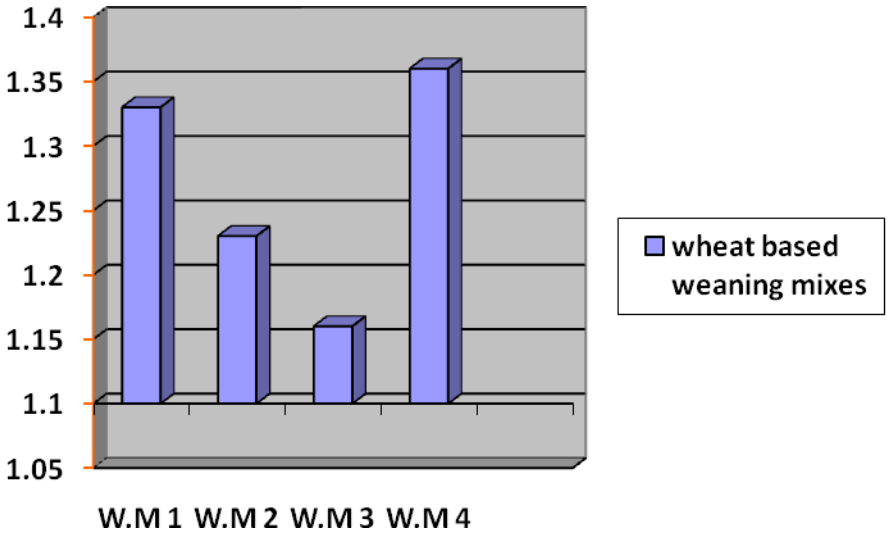

Image 5: Water retention capacity of different types of wheat based weaning mixes.

Image 5 is showing highest water retention capacity of W4 (wheat, soyabean, papaya based mix). It can lead to lower shelf life as this sample is more prone to absorb more environmental moisture that gives favourable conditions for growth of microorganisms. It can lead to lower shelf life.

c. Swelling index of weaning mixes

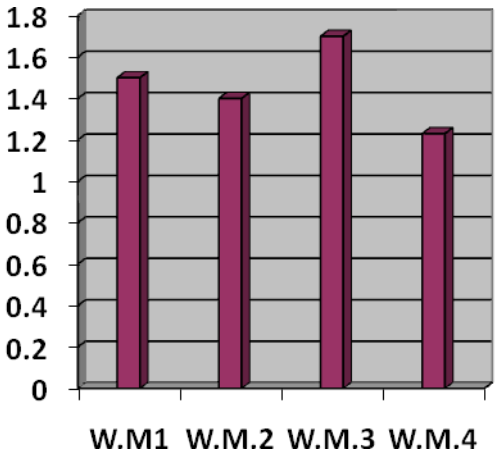

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Image 6: Swelling index of weaning mixes.

Image 6 is showing swelling index of different weaning mixes that is showing highest swelling index for W3 (wheat, soyabean, pumpkin) although the difference was not significant statistically when compared to other samples. High swelling index represents that the powder will gain more moisture, lower shelf life & thick consistency with similar amount of water.

3. Nutritive Value of all 4 weaning mixes

Mix	Ingredient	Quantity gm	Calorie Kcal	Protein gm	CHO gm	Fat Gm	Iron Mg	Calcium Mg	Vitamin C Mg
W.M.1	Wheat	50G	160	5.28	32	0.76	1.98	19.68	-
	Moth	25 G	77.2	4.93	13	0.44	1.97	38.5	-
	Papaya	25 G	5.7	0.15	1.1	0.57	0.05	5.68	5.18
	Milk powder	25 G	111.1	5	14.45	3.75	-	-	-
	Sugar	25 G	100	-	25	-	-	-	-
	In total	150 G	454.4	15.36	85.55	5.52	4	63.86	5.18
	In	**100 G**	**302.9**	**10.24**	**57.03**	**3.68**	**2.66**	**42.57**	**3.45**
W.M.2	Wheat	50G	160	5.28	32	0.76	1.98	19.68	-
	Moth	25 G	77.2	4.93	13	0.44	1.97	38.5	-
	Pumpkin	25 G	6.1	0.21	1	0.04	0.07	6	1.82
	Milk powder	25G	111.1	5	14.45	3.75	-	-	-
	Sugar	25G	100	-	25	-	-	-	-
	In total	150 G	454.4	15.42	85.45	4.99	4.02	64.18	1.82
	In	**100 G**	**302.93**	**10.28**	**56.96**	**3.32**	**2.68**	**42.78**	**1.21**
W.M.3	Wheat	50G	160	5.28	32	0.76	1.98	19.68	-
	Soyabean	25 G	95.5	8.8	3.19	4.9	2.07	59.75	-
	Papaya	25 G	5.7	0.15	1.1	0.57	0.05	5.68	5.18
	Milk powder	25G	111.1	5	14.45	3.75	-	-	-
	Sugar	25G	100	-	25	-	-	-	-
	In total	150 G	472.3	19.23	75.74	9.98	4.1	85.11	5.18
	In	**100 G**	**314.86**	**12.82**	**50.49**	**6.65**	**2.73**	**56.74**	**3.45**
W.M.4	Wheat	50G	160	5.28	32	0.76	1.98	19.68	-
	Soyabean	25 G	95.5	8.8	3.19	4.9	2.07	59.75	-
	Pumpkin	25 G	6.1	0.21	1	0.04	0.07	6	1.82

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	Milk powder	25G	111.1	5	14.45	3.75	-	-	-
	Sugar	25G	100	-	25	-	-	-	-
	In total	150 G	472.7	19.29	75.64	9.45	4.12	85.43	1.82
	In	**100 G**	**315.13**	**12.86**	**50.42**	**6.3**	**2.74**	**56.95**	**1.21**

Table 5: Nutritive value of different types of weaning mixes.

Table 5 is representing nutritive profile of different types of weaning mixes. It is evident that soyabean based weaning mixes (WM 3 & WM 4) were higher in energy, protein, fat and calcium. Papaya based samples (W1 & W3) showed significantly higher vitamin C levels. It may be due to higher vitamin C levels of papaya in comparison to pumpkin (IFCT, 2017)

4. Shelf life study

Samples were kept in an airtight container for 3 months. After which these were again evaluated for their acceptability & plate waste method after each 30 days.

S. No	Weaning mixes	30 days	60 days	90 days
1	W.M. 1	8.3±0.6	8.0 ± 0.215	7.5 ± 0.244
2	W.M. 2	8.3±0.538	8.0 ± 0.302	7.0 ± 0.145
3	W.M. 3	7.9±0.748	7.6 ± 0.132	7.2 ± 0.256
4	W.M. 4	8.0±0.632	7.7 ± 0.114	7.5 ± 0.111

Table 6: Mean overall acceptability score at different time periods

Mean overall acceptability score of all 4 weaning mixes was reduced after each 30 days although the reduction was statistically not significant. All four samples were almost equally acceptable by panel of judges.

Weaning mixes	Mean consumption (gm)			
	0 day	30 day	60 day	90 day
W.M.1	16 g	16 g	15 g	10 g
W.M.2	20 g	20 g	18 g	15 g
W.M.3	10 g	9 g	6 g	5 g
W.M.4	10 g	8 g	6 g	5 g

Table 7: Mean consumption of weaning mixes on the basis of plate waste method

Above table 7 is depicting the mean consumption in g out of 20 g sample served to infants in the age bracket of 6-12 months. It is evident that consumption was not affected during 30 days, but after 60 days, it was reduced slightly and after 90 days, infants found it significantly less acceptable.

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Conclusion

The developed weaning mixes were acceptable by infants & after different processing methods & addition of pulses, fruits & vegetables these became more nutritious also. Therefore, results suggest that value addition of the weaning mixes are of great importance to the infant's health.

References

1. Agostoni, C., Fiocchi, A., Riva, E., Terracciano, L., Sarratud, T., Martelli, A., & Giovannini, M. (2007). Growth of infants with IgE-mediated cow's milk allergy fed different formulas in the complementary feeding period. *Pediatric allergy and immunology*, ***18*****(7)**, 599-606.

2. Bulusu, S., Laviolette, L., Mannar, V. & Reddy, V. (2007). Cereal fortification programs in developing countries. *Issues in Complementary Feeding*, ***60***, 91-105.

3. Dogra, J., Dhaliwal, Y.S. & Manoranjan, K. (2004). Effect of soaking, germination, heating and roasting on the chemical composition and nutritional quality of fababean and utilization in preparation of various Indian leavened products. *J of Dairying Food & Home Sciences,* **23(1)**, 1-8.

4. Dutta, M., & Sharma, M. (2020). Complementary foods: A review on types, techniques and nutritional content.
5. El-Adawy, T. A., Rahma, E. H., El-Bedawy, A. A., & Sobihah, T. Y. (2000). Effect of soaking process on nutritional quality and protein solubility of some legume seeds. *Food/Nahrung*, ***44*****(5)**, 339-343.

6. Fabiyi, E. F. (2006). Soyabean processing, utilization and health benefits. *Pakistan journal of nutrition*, ***5*****(5)**, 453-457.

7. Indian Food Composition Tables (2017). Editors - Longwa T., Ananthan R., Bhaskarachary K. & Venkaiah K. National Institute of Nutrition, Hyderabad - 500 007, India.

8. Matz, S.A. (1991). The chemistry and technology of cereals as food and feed. AVI book, SPRINGER, http://books.google.fr/books?id=WKY0h5YrQVwC**.**

9. McConnell, .A., Eastwood, M.A. & Michell, W.D. (1974). Physical characteristics of vegetable food stuffs that could influence bowel function. *J of the Sci. Food & Agri*. https://doi.org/10.1002/jsfa.2740251205**.**

10. Negi, A. (2003). Development and incorporation of fruit powders for value addition of cereal based food products. (Doctoral dissertation, Chaudhary Charan Singh Haryana Agricultural University; Hisar).

11. Ranganna, S. (1986). Handbook of analysis and quality control for fruits and vegetable products. Second edition.

12. Singh, A.K., Rehal, J. & Kaur, A. & jyot, G. (2015). Enhancement of attributes of cereals by germination and fermentation; A Review. *Critical Reviews in Food Sci. Nutr*. **55 (11)**, 1575 – 1589.

13. Srilkshmi, B. (2018). Food Science. New Age International publishers.

14. UNICEF (2017). The state of the world's children. https://www.unicef.org/reports/state-worlds-children-1998.