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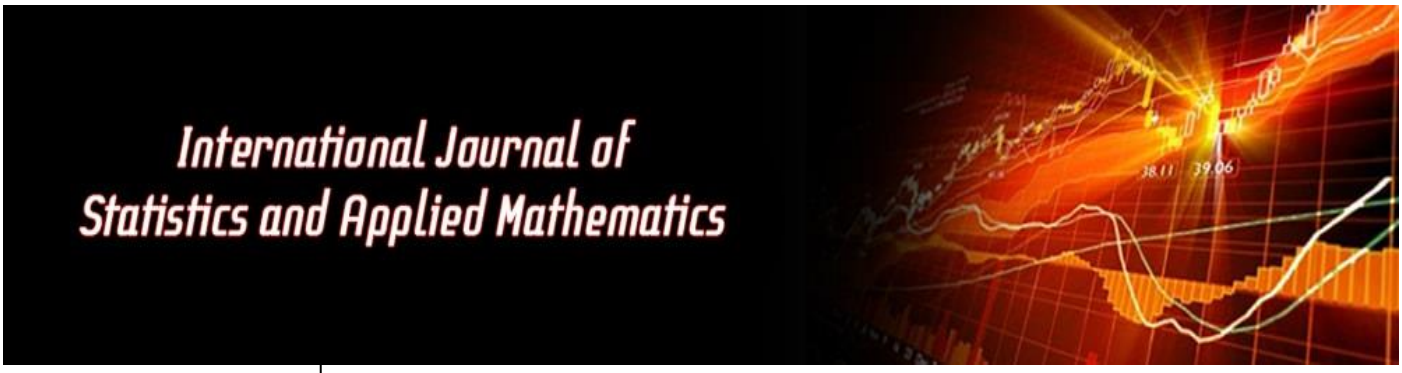

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Mala Kumari
Department of Extension Education and Communication Management, College of Community Science, RPCAU, Pusa, Samastipur, Bihar, India

MN Ansari
Department of Extension Education, TCA, Dholi, RPCAU, Pusa, Samastipur, Bihar, India

Gayatri
Department of Textile & Apparel Designing, College of Community Science, RPCAU, Pusa, Samastipur, Bihar, India

Kumari Shipra
Department of Extension Education & Communication Management, College of Community Science, RPCAU, Pusa, Samastipur, Bihar, India

Corresponding Author:
Mala Kumari
Department of Extension Education and Communication Management, College of Community Science, RPCAU, Pusa, Samastipur, Bihar, India

Development of low-cost weaning mix for combating malnutrition among rural infants in Begusarai District of Bihar

Mala Kumari, MN Ansari, Gayatri and Kumari Shipra

Abstract
To fulfil the increased nutrient needs of the growing infant, four weaning foods based on rice, wheat, maize and ragi have been prepared. Greengram, groundnuts and gingerly seeds were selected from pulse, and nuts and oilseeds groups respectively to supplements the weaning foods with many important nutrients. The level of protein, iron, phosphorous, thiamine and niacian was above the adequate level in all four weaning foods whereas no weaning food met the adequate fat and vitamin A level. The levels of calcium and riboflavin in ragi- based weaning food were sufficiently good.

Keywords: Wining mix, mal nutrition, rural infants

Introduction
All four weaning foods can be easily used to feed the infant as these are low-cost nutritious food and the procedure followed for their preparation is very simple. The use of milk together with weaning food can further enrich the food with fat, vitamin A, calcium and other important nutrients. Breast-feeding is the best form of infant feeding for all segments of the population in all countries. It provides approximate nutrients and other factors in adequate quantities to ensure optimal growth in early infancy. But, breast milk alone is insufficient to meet the nutrient needs of a growing infant after 4 to 6 months, (NIN 1998) [2]. Hence weaning food must gradually, be introduced to an infant at this age, so that a slow and smooth transition from breast milk to a diet consisting essentially of adult foods can be achieved.
Under nutrition was reported to vary substantially with the age of the child, being highest after the first six months. The problem of under nutrition and wasting among Infants is high in Bihar densely populated state of India (IIPS, 1995) [1]. Several factors hasten the rapid decline of under nutrition, especially from the sixth months of life. Improper nourishment is one of the most important factors. An attempt has been made through the present investigation to develop low-cost nutritious weaning foods from locally available food materials.

Materials and Methods
Selection of food materials
Commonly consumed cereals/millets of Bihar namely rice, wheat, maize and ragi were selected for development the weaning foods. Greengram is the commonly consumed pulse in the region whereas groundnuts and gingelly seeds are widely accepted food materials among nuts and oilseeds. Greengram, groundnuts and gingelly seeds were added separately to the four selected portions of cereal/millet to supplement the weaning food with many important nutrients. Thus, four weaning foods based on rice, wheat, maize and ragi were developed

Procedure to prepare weaning food

S. No	Ingredients	Weight (Grams)
1.	Cereal/millets	150
2.	Green grams	100
3.	Groundnuts	20
4	Gingelly seeds	20

Weaning food W1 Parboiled Rice + All other ingredients.
Weaning food W2 Wheat +All other ingredients.
Weaning food W3 Maize + All other ingredients.
Weaning food W4 Ragi +All other ingredients.

All the ingredients were cleaned separately and roasted carefully until the desirable flavour was obtained. The roasted ingredients were powdered INA grinder and mixed thoroughly. These weaning foods (W1, W2, W3 and W4) can be readily used by mixing with hot water or milk with a little sugar/jaggery. The nutritive value of these weaning foods was determined by using the values given by the National Institute of Nutrition (1991) [2] for common Indian foods. Hence, the composition of nutrients gives only the calculated values which would differ with the variety of grain used.

Results and Discussion

The nutritive value and cost of all weaning food (per 100g) have been determined and presented in Table 1.

Table 1: Composition and cost of weaning foods prepared from locally available food materials

Nutrients	Weaning food (100g)			
	W1	W2	W3	W4
Energy (K-Cal)	416	424	435	410
Protein (g)	16.35	19.80	20.02	17.06
Fat (g)	7.00	7.78	9.29	7.60
Calcium (mg)	149.77	171.28	158.16	344.77
Iron (mg)	3.0	5.55	3.93	4.70
Phosphorus (mg)	307.03	407.75	446.0	391.35
B-carotene (µg)	23.19	60.85	78.4	47.69
Thiamine (mg)	0.41	0.59	0.55	0.53
Riboflavin (mg)	0.15	0.22	0.18	0.23
Niacin (mg)	5.10	5.48	4.16	3.60
Cost (Rs.)	3.58	3.43	3.23	3.72

The four weaning foods were found to be similar concerning energy, protein and fat content. Comparatively, the energy value (435 K-Cal/100g), protein content (20.02g/100g) and fat content (9.29g/100g) of maize - based weaning food (W3) were high. It was also higher in phosphorus (446.0 mg/100g) and beta-carotene contents (78.4 µg/100g) as compared to others.

The amount of calcium, one of the most important nutrients for rapidly growing infants was very high in ragi-based weaning food (344.77 mg/100g) being approximate twice the calcium content of the other three weaning foods (W1-: 149.77 MG/100g; W2-: 171.28 mg/100g and W3-: 158.16 mg/100g) of wheat based weaning food (W2) were comparatively higher. The riboflavin contents of wheat based (W2) weaning food (0.22 mg/100g) and ragi-based (W4) weaning foods (0.23 mg/100g) were much the same.

Cost-wise, all weaning foods were considerably cheaper than similar commercial foods. It is noteworthy that all weaning foods involved locally available food materials. The cost involved in the preparation of 100g of weaning food was highest for the ragi-based food (Rs. 3.72/-) followed by the rice (Rs. 3.58/-), wheat (Rs. 3.43/-) and maize (Rs. 3.23/-) based foods. The level of nutrients present in weaning food (per 100 K-Cal) deciding the quality of weaning food has been presented in Table 2.

Table 2: Nutrient level in weaning food (Per 100 K-Cal)

Nutrients	Level per 100 K-Cal					
	Adequate	Not to exceed	W1	W2	W3	W4
Protein (g)	1.8	4.5	3.93	4.67	4.6	4.16
Fat (g)	3.3	6.0	1.68	1.83	2.14	1.85
Minerals						
Calcium (mg)	60.00	-	36.02	40.40	36.36	84.04
Iron (mg)	0.15	2.5	0.72	1.31	0.90	1.15
Phosphorus (mg)	30.0	-	73.83	96.16	102.52	95.40
Vitamins						
Vit A (I.U.)	250	750	9.3	23.92	30.03	19.38
Thiamine (mg)	0.04	-	0.10	0.14	0.13	0.13
Riboflavin (mg)	0.06	-	0.04	0.05	0.04	0.06
Niacin (mg)	0.25	-	1.23	1.29	0.96	0.88

The level of protein present in all weaning food is almost within the normal range (1.8 to 4.5g/100 K-Cal). The level of protein in wheat based weaning food was comparatively higher. The fat content of any of the four weaning foods did not meet the adequate level. The level of iron present in all food was above the adequate level. But in the case of calcium, only ragi-based weaning food crossed the line of adequate level (60.0 mg/100 K-Cal). The other three weaning foods were very low in calcium content. The level of phosphorus in all weaning foods was more than twice the adequate level. Fortunately, there is no maximum limit for phosphorus in infant food because phosphorus also along with calcium is essential for the growth and development of infants.

Thiamin and niacin were present at more than adequate levels in all the four weaning foods but the riboflavin content of only ragi-based weaning food met the adequate level. Based on their composition all four weaning foods can be recommended for infants. For better performance, weaning foods should be mixed with milk and sugar/jaggery before giving to infants to enrich the food further with other nutrients present in milk.

Conclusion

The development of a low-cost weaning mix to address the pervasive issue of malnutrition among rural infants in Begusarai District, Bihar, represents a significant step towards improving the health and well-being of this vulnerable population. The study has showcased the potential of locally sourced, affordable ingredients and innovative nutritional strategies in combating malnutrition. Malnutrition, particularly in its most critical form, stunts the physical and cognitive growth of children and jeopardizes their future. This study has highlighted that addressing malnutrition at an early stage is essential, and the weaning phase is a pivotal opportunity for intervention. By developing a low-cost weaning mix, tailored to the local context and nutritional needs, we have taken a step in the right direction. One of the most significant achievements of this study is the creation of a weaning mix that is not only nutritious but also cost-effective. By utilizing locally available ingredients and adhering to affordability

constraints, we've ensured that the weaning mix can be accessible to the rural population. This factor is crucial, as financial constraints often exacerbate the challenges of malnutrition

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