POTENTIALS OF EXTRUDED QUALITY PROTEIN MAIZE-SOYBEAN PROTEIN CONCENTRATE COMPLEMENTARY MEAL IN THE TREATMENT OF PROTEIN-ENERGY MALNUTRITION

BY

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Introduction

- Malnutrition is still a major health problem in developing countries. Formulation of nutritious complementary diets is expected to improve health and nutritional status of growing children.
- The critical period for growth is in the first 2 years of life when growth faltering can result in stunting and underweight.
- The diagnosis of malnutrition is mainly clinical. PEM has multiple effects on the young child. Child undernutrition is responsible for approximately 3.5 million deaths in children below the age of 5 years and for 35% of the disease burden in this age group.

- The use of ready-to-use foods with long shelf lives in the treatment and prevention of malnutrition has increased in recent years.
- The production process involved in the production of the soybean protein concentrate and the extrusion cooking significantly reduced the antinutritional factors in the final products and improved the protein and starch digestibility of the formulated meal.
- Addition of soybean protein concentrate to maize resulted in an improved diet. The limiting amino acids in the raw materials on a separate basis were improved in the formulated diet from a combination of the quality protein maize and soybean protein concentrate. (Omosebi et al., 2018)

Objective

- Assess the proximate composition and mineral content of the extruded formulated complementary diet from quality protein maize, soybean protein concentrate and cassava starch,

- And evaluate clinically the potentials of the meal in the management of Protein Energy Malnutrition (PEM).

Materials and Methods

- Consumer friendly variety of Cassava roots (TMS 4(2) 1425) was purchased from International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria. Soybeans (TGx1987-10F) was purchased from International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria. Quality protein maize (ART/98/SUWN/SR) was purchased from Institute of Agricultural Research and Technology (IAR&T), Ibadan, Nigeria.

- The cassava starch was processed using the method described by Osundahunsi *et al.*, (2011).

- The soybean protein concentrate was processed using the method described by Adebowale and Lawal (2003).

- The maize meal, soybean protein concentrates and cassava starch (72%, 18.94% and 9.06% respectively) were mixed in proportions to reach the target protein content of at least 18% (using regression analysis). The mixture was extruded.

- The proximate composition of the formulated meal was determined by the method described by AOAC (2010).
- The mineral content was evaluated using the inductively-coupled plasma atomic emission spectrometer (ICPAES) (Model: Questron Technologies Corp. TL 6000)
- The extruded meal and a commercial control were fed to 10 children in the child welfare clinic of the Oyo State hospital, Oyo for 8 weeks for nutritional rehabilitation. Anthropometric data (head circumference, weight, mid-upper arm circumference) on the subjects were taken on weekly basis.

Table 1. Proximate composition of extruded meal (% dry weight) of QPM, soybean concentrate and cassava starch.

Sample Id	Crude Protein (%)	Crude Fat (%)	Total Ash (%)	Crude Fibre (%)	Moisture Content (%)	Carbohydrate (%)	Gross Food Energy (KJ)
EFA	21.00^{a}±0.16	6.65^{b}±0.59	2.14^{a}±0.05	2.13^{a}±0.01	8.72^{b}±0.10	68.08^{a}±0.15	1741.26^{a}
*FAO/WHO Patterns	>16.70	>6.0	-	-	<10	-	>1575

EFA: Extruded formulated meal. * Based on FAO/WHO standard values reported by Osundahunsi and Aworh, (2003). Values with different superscript on the same column are significantly different $P \leq 0.05$

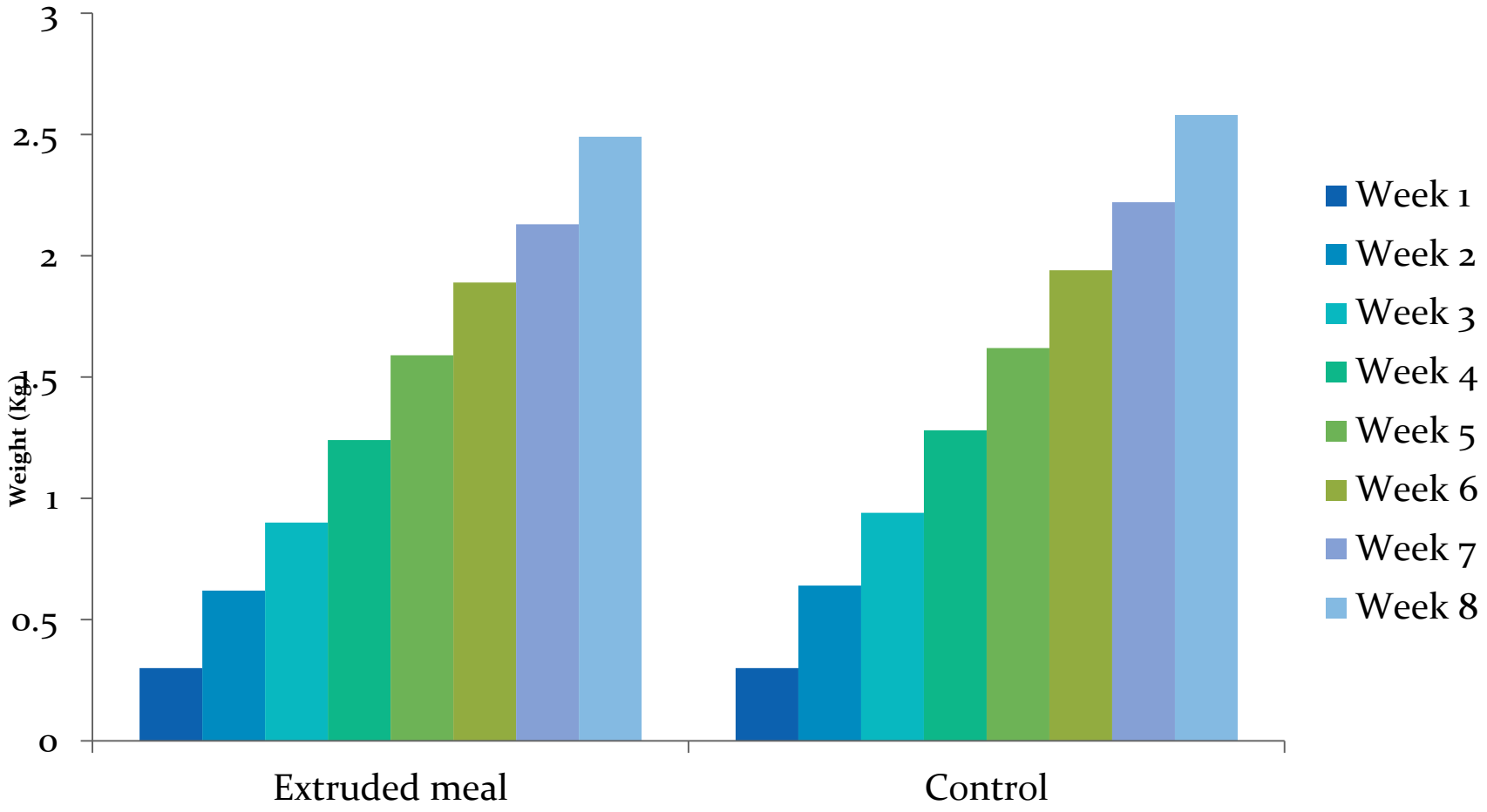

Figure 1. Increase in weight during diet therapy over a period of 8 weeks

Table 2. Packed Cell Volume, Haemoglobin concentration, Total protein and Serum albumin of blood samples of the PEM children fed the extruded meal of QPM, soybean concentrate and cassava starch and control diet.

Child	Packed Cell Volume (%)		Haemoglobin (g/100ml)		Total Protein (g/100ml)		Serum Albumin (g/100ml)	
	Before	After	Before	After	Before	After	Before	After
1 EFA	29.3	32.0	10.6	12.8	5.80	7.45	3.1	4.5
2 EFA	29.5	32.0	9.8	12.0	4.62	7.18	2.4	4.0
3 EFA	28.0	31.0	10.5	12.8	5.16	7.81	3.1	4.2
4 EFA*	25.0	30.3	8.3	10.5	4.50	6.92	3.8	4.5
5 EFA	30.7	33.6	10.4	12.0	6.10	8.30	2.8	3.8
6 CD	24.0	31.0	8.1	11.0	4.20	6.44	1.8	3.6
7 CD*	27.0	30.0	9.0	11.6	4.16	6.85	2.6	4.0
8 CD*	26.0	30.7	8.6	11.8	4.12	6.24	2.6	3.8
9 CD	30.3	32.5	10.8	12.2	5.20	7.20	3.0	4.2
10 CD	22.0	34.0	8.0	11.0	4.14	7.28	2.5	4.2
Minimum Normal	30 %		10g/100ml		5-7g/100ml		3g/100ml	

Table 3. Anthropometric measurement (length, weight, MUAC) of the children fed the extruded meal of QPM, soybean concentrate and cassava starch before and after treatment period and control diet.

Infant	Initial Age (months)	Initial Percentile	Length (cm)		Final Percentile	Initial Percentile	Weight (kg)		Final Percentile	Mid Upper arm circumference (cm)	
		Before		After		Before		After		Before	After
1 EFA	12	<50	73.0	76.5	>50	=5	7.3	9.3	=50	14.5	15.9
2 EFA	10	<50	72.0	75.0	=50	2-5	7.0	9.5	≥75	13.5	15.0
3 EFA	8	=50	69.0	72.0	>50	<2	6.5	9.0	>50	12.5	14.3
4 EFA*	15	=50	80.0	83.5	=75	2-5	8.0	10.4	≥75	13.8	15.5
5 EFA	17	<50	79.0	83.0	>50	2-5	8.5	11.1	≥75	14.1	15.5
6 CD	12	<2	63.0	65.0	<2	<2	4.7	7.8	=2	10.3	12.0
7 CD*	9	=50	72.0	75.2	>75	5-10	7.6	10.0	≥75	14.3	15.7
8 CD*	10	=50	73.0	75.5	>50	<2	6.7	9.1	>50	13.0	14.3
9 CD	8	=50	68.5	73.2	=75	5-10	6.6	9.0	>50	13.5	15.0
10 CD	9	=50	70.5	73.7	>50	=2	6.4	9.0	>50	12.5	14.7

EFA: Extruded Formulated Meal. CD: Control Diet (Cerelac). MUAC: Mid Upper arm circumference *Male children

Table 4: Anthropometric measurement (Head:Chest ratio, triceps and subscapular) of the children fed the extruded meal of QPM, soybean concentrate and cassava starch and control diet before and after treatment period

Infant	Age (months)	Head : Chest		Triceps (mm)		Subscapular (mm)	
		Before	After	Before	After	Before	After
1[EFA]	12	1.05	0.98	10	14	6	8
2[EFA]	11	0.98	0.94	10	14	6	7
3[EFA]	8	1.04	0.96	10	14	5	8
4[EFA]*	16	0.98	0.94	7	13	5	8
5 [EFA]	18	0.99	0.94	9	13	5	8
6[CD]	12	1.08	1.02	6	9	3	7
7 [CD]*	9	0.98	0.96	9	13	6	8
8 [CD]*	10	1.00	0.97	7	10	4	6
9 [CD]	8	1.00	0.96	9	14	5	6
10 [CD]	9	1.07	0.99	9	13	5	7

EFA: Extruded Formulated Meal CD: Control Diet (Cerelac) *Male children

Table 2. Mineral composition (mg/100g) of the extruded meal of QPM, soybean concentrate and cassava starch.

Mineral	EFA
Sodium (mg/100g)	58.80±1.5[a]
Potassium (mg/100g)	421.45±1.9[a]
Iron (mg/100g)	22.24±1.5[a]
Magnesium (mg/100g)	56.21±0.9[a]
Calcium (mg/100g)	379.48±2.2[a]
Phosphorus (mg/100g)	422.70±2.0[a]
Zinc (mg/100g)	5.33±0.8[a]
Copper (mg/100g)	8.52±0.7[a]
Ca/P	1.11
K/Na	6.75
Ca/Mg	0.15

EFA: Extruded formulated meal
Values are means and standard deviations of three determinations.
Values not followed by the same superscript in the same row are significantly different ($p<0.05$).

Conclusion

- Addition of soybean protein concentrate to quality protein maize improved the diet.
- Most of the minerals present met the minimum requirement for complementary diets.
- Experience from industrialized countries indicates that one of the best strategies to eliminate or markedly reduce micronutrient malnutrition globally is through food supplementation, with the goal of increasing the level of consumption of added nutrients to improve the nutritional status of the target population.
- The result of this study confirmed other authors' view that anaemia is a common finding in Protein Energy Malnourished children and the condition improves as the children are given therapeutic treatment.
- Most clinical signs of nutritional deficiency disappeared after treatment with the developed diet. The meal can be used to a considerable advantage in the treatment of protein energy malnutrition.