EVALUATION OF PROXIMATE COMPOSITION, FUNCTIONAL PROPERTIES, AND MINERAL CONTENT OF COMPOSITE FLOUR PRODUCED FROM CEREAL-LEGUME BLENDS

Stephen Ayisi-Larbi[1], Yaw Agyei Gyasi, Jonathan Awewomom, Robert Agbemafle

Department of Chemistry, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana

***Correspondence:** *sayisilarbi@knust.edu.gh*

INTRODUCTION

- Nutrition is crucial for proper growth, vision and brain development. A healthy diet during childhood and adolescence is essential for general body growth. Inadequate and a low-quality diet are likely to affect the growth, vision and cognitive function of children.
- Africa is one of the continents with the highest prevalence of malnutrition with an estimated 282 million of its adult and children population affected. In Ghana, every one in four children suffer stunted growth from malnourishment (Aboagye et al., 2022).
- Cereals and legumes have found utmost acceptance across the globe because they are high in protein, low in saturated fat, and contain some key micronutrients (zinc, folate, and calcium and tocopherols) which contributes to health (Berhane et al., 2020).
- Many existing studies pay closer attention to children under five years of age but few studies have considered pre-adults.
- This study sought to evaluate the nutritional profile of cereal-legume flour and to promote public awareness of its health benefits.

OBJECTIVES

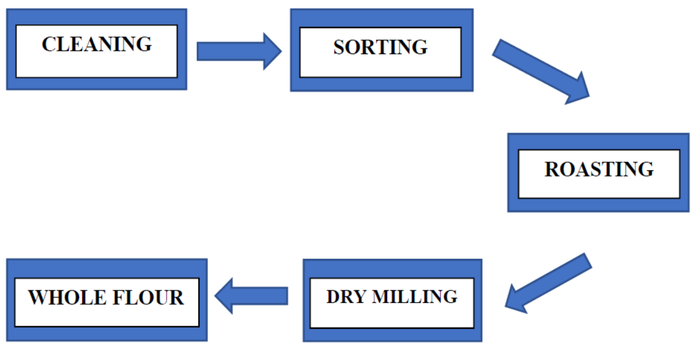
MAIN OBJECTIVE

This study aimed to evaluate the proximate composition, functional properties and mineral content of composite flours produced from cereal-legume blends

SPECIFIC OBJECTIVES

- To determine the moisture content, ash, soluble carbohydrate, fats and protein values of composite flours made from wheat, maize, soybean and oats flour blends.
- To investigate levels of iron, zinc, calcium, sodium, potassium, copper, magnesium and phosphorus of the cereal-legume flour.
- To determine the water absorption capacity (WAC), oil absorption capacity (OAC), emulsion properties, swelling power (SP), and bulk density (BD) of the cereal-legume flour.

METHODOLOGY



Other relevant techniques:

- Washing
- Sun drying
- Sieving

RESULTS

Table 1: Proximate Composition

PROXIMATE COMPOSITION OF THE COMPOSITE SAMPLES

SAMPLE	% MC	% ASH	% FAT	% PROTEIN	% CHO
1	4.056±0.301^{b}	2.186±0.009^{c}	7.117±0.100^{c}	18.385±0.328^{c}	58.266±0.322^{b}
2	4.137±0.350^{b}	2.173±0.025^{c}	6.868±0.074^{c}	18.552±0.278^{c}	55.946±0.885^{c}
3	3.657±0.314^{b}	2.633±0.028^{b}	9.220±0.105^{b}	22.957±0.527^{b}	48.874±0.256^{d}
4	1.933±0.795^{c}	3.571±0.066^{a}	10.378±0.162^{a}	40.448±0.260^{a}	38.388±0.453^{e}
5	5.409±0.374^{a}	2.047±0.013^{d}	4.884±0.097^{d}	16.168±0.025^{d}	60.592±0.341^{a}
p-value	0.000	0.000	0.000	0.000	0.000

M C = Moisture Content; **CHO** = Soluble Carbohydrate

Table 2: Functional Properties

FUNCTIONAL PROPERTIES OF THE COMPOSITE SAMPLES

SAMPLE	SC (g/ml)	BD (g/ml)	WAC (%)	OAC (%)
1	37.000±1.000^{b}	0.667±0.000^{c}	256.670±5.770^{b}	203.330±5.770^{a}
2	37.330±2.080^{b}	0.714±0.000^{b}	260.000±0.000^{ab}	203.330±5.770^{a}
3	38.667±0.557^{ab}	0.714±0.000^{b}	273.330±5.770^{a}	206.670±5.770^{a}
4	35.333±1.155^{b}	0.769±0.000^{a}	253.330±5.770^{b}	206.670±5.770^{a}
5	42.000±2.000^{a}	0.683±0.028^{bc}	253.330±5.770^{b}	200.000±0.000^{a}
p-value	0.003	0.000	0.004	0.512

SC= Swelling Capacity; **BD**= Bulk Density; **WAC**= Water Absorption Capacity; **OAC**= Oil Absorption Capacity

Table 3: Functional Properties

FUNCTIONAL PROPERTIES OF THE COMPOSITE SAMPLES

SAMPLE	EMULSION ACTIVITY (%)	EMULSION STABILITY (%)
1	3.846±0.000^{c}	5.128±1.110^{b}
2	5.128±1.110^{bc}	6.410±1.110^{b}
3	5.128±1.110^{bc}	5.128±1.110^{b}
4	8.333±1.110^{b}	5.128±1.110^{b}
5	16.030±2.940^{a}	9.615±0.000^{a}
p-value	0.000	0.001

Table 4: Mineral Content

MINERAL CONTENT OF THE COMPOSITE SAMPLES

SAMPLE	Ca (%)	Mg (%)	P (µg/g)	Fe (µg/g)
1	1.112±0.098^{a}	0.087±0.005^{b}	4224.400±33.800^{c}	274.720±12.130^{a}
2	0.759±0.009^{b}	0.083±0.001^{b}	4440.300±26.200^{b}	245.990±2.930^{b}
3	0.711±0.006^{b}	0.080±0.008^{b}	3493.010±8.950^{e}	141.710±1.012^{d}
4	1.009±0.033^{a}	0.094±0.008^{b}	6216.500±69.400^{a}	204.330±2.730^{c}
5	0.744±0.011^{b}	0.143±0.033^{a}	3761.000±47.200^{d}	239.470±1.980^{b}
p-value	0.000	0.004	0.000	0.000

Values are means ± SD of triplicate determinations

Means differently superscripted along the vertical columns are significantly different ($p<0.05$)

Legend:

1= 25:25:25:25 2= 50:20:20:10 3= 20:20:50:10 4= control (Soybean flour)

5= control (wheat flour)

Sample ratio: (wheat: maize: soybean: oats)

RESULTS

Table 5: Mineral Content

MINERAL CONTENT OF THE COMPOSITE SAMPLES

SAMPLE	Cu (µg/g)	Zn (µg/g)	K (µg/g)	Na (µg/g)
1	201.980±7.780^{b}	194.420±3.280^{c}	5748.9±67.300^{b}	2882.5±62.100^{b}
2	191.580±3.000^{b}	227.420±2.710^{a}	5683.5±70.600^{b}	2621.2±47.100^{c}
3	188.670±10.420^{b}	170.355±0.554^{d}	5682.0±174.00^{b}	2196.79±6.210^{d}
4	294.850±3.550^{a}	214.380±8.650^{b}	12625.3±46.90^{a}	5920.7±58.900^{a}
5	169.310±3.160^{c}	170.599±1.115^{d}	5238.3±105.50^{c}	2279.0±33.330^{d}
p-value	0.000	0.000	0.000	0.000

Table 6: Role of dietary minerals in food

Mineral	Role
Phosphorus (P)	Contributes to the formation of strong bones and teeth in children and nerve functioning.
Potassium (K)	Helps to counterbalance the effects of sodium on blood pressure.
Sodium (Na)	Maintains fluid balance and blood pressure essential for muscle contraction and nerve transmission in the body.
Calcium (Ca)	Primary mineral for building and maintain strong bones and teeth development. Essential for blood clotting and nerve signaling.
Iron (Fe)	Core component of hemoglobin, which carries oxygen in red blood cells in the body.
Magnesium (Mg)	Supports a steady heartbeat and bone health. Regulates muscle and nerve function.
Zinc (Zn)	Helps in wound healing and protein metabolism. Required for taste and smell senses.
Copper (Cu)	Acts as a cofactor for energy production and antioxidant enzymes. Facilitates iron absorption and transport.

CONCLUSION

The study showed that supplementing cereal diet with legumes significantly increases the nutritional profile of the final formulated product and can advantageously compensate for other minerals which may be in trace quantities or absent in individual whole meals. Again, the functional property of food provides useful information on the physical behavior of foods or food ingredients during their preparation, processing, or storage.

REFERENCES

- Aboagye, R. G., Kugbey, N., Ahinkorah, B. O., Seidu, A. A., Cadri, A., Bosoka, S. A., Akonor, P. Y., & Takase, M. (2022). Nutritional status of school children in the South Tongu
- Berhane, H. Y., Jirström, M., Abdelmenan, S., & Berhane, Y. (2020). Social Stratification, Diet Diversity and Malnutrition, Addis Ababa. *Nutrients, MDPI*, *12*, 5–7.