

## IMPACT OF FERMENTATION PROCESS ON THE AMINO ACID PROFILE OF BLENDS OF TWO CULTIVARS OF MAIZE (*ZEA MAYS*)

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### ABSTRACT

This work determined the Impact of fermentation process on the amino acid profile of blends of two cultivars of maize (*Zea mays*). The two maize cultivars (yellow maize and popcorn) were cleaned, milled, dampened with sterile water in a sterile conical flask. It was fermented for 48 hrs, dried, milled and packaged. Different proportion of the maize flours were blend together and amino acid profiles were determined. Sample CC (25 % yellow maize and 15 popcorn flour) had higher asparagine content (8.31 %), alanine (5.14 %), isoleucine (4.86 %), lysine (4.87 %), methionine (4.27 %), threonine (3.24 %), essential amino acid (35.81 %), Non-essential amino acid (57.03 %) and total amino acid (92.84 %). The limiting essential amino acids in the maize blends were lysine, aromatic amino acids and threonine. The amino acid scores revealed that fermented maize blends could not support growth of school age children but could repair the worn out tissues in adult. Fermentation process increased the amino acid composition of the fermented maize blends.

**Keywords:** Amino acids, Cultivar, Fermentation, Maize, Popcorn.

### INTRODUCTION

Maize (*Zea mays* L.) is an important cereal grain in the world, providing nutrients for humans and animals (FAO, 1992; Vassal *et al.*, 1993). Maize is used as human food in the form of tortillas, porridge, popcorn and barbecues and as forage and silage for animals. It is also a good source of industrial products such as starch, vitamin, fiber, oil, weaning food, porridges and ethanol (Abiose and Ikujenlola, 2014). Maize is a major source of dietary energy for low income consumer in many parts of tropical Africa, including major urban areas (Adeoti *et al.*, 2013). However, utilization of maize generally is limited by its extremely low protein content and the consumption of its products has been implicated in malnutrition (Adeoti *et al.*, 2013). Processes such as fermentation, malting, cooking and fortification had been reported to improve the qualities of food products (Odunfa, 1988; Onilude *et al.*, 1999; Onyeka and Dibia, 2002). Food fermentation is regarded as one of the oldest ways of food processing and preparation (Achi, 2005). Fermentation by desirable organisms impart flavor, bouquet and texture to the fermented foods thereby adding to their nutritive value, flavor and other qualities associated with edibility (Ihekoronye and Ngoddy, 1985; Oloyede *et al.*, 2013). Fermentation was observed to lower the proportion of dry matter in the food and increases the concentrations of vitamins, minerals and protein (Adams, 1990; Sahlin, 1999). However, reduction in anti-nutritional factors of food during fermentation had been reported (Paredes-López and Harry, 1988). Lactic fermentation of maize meal decreased phytate phosphorus by 78% (Chompreeda and Fields, 1984). Fermented maize flour could find its application in infant food production, composite flour, gruel and in making sour food products. The objective of this work was to evaluate.

## MATERIALS AND METHODS

### Materials

The impact of fermentation process on the amino acid profile of blends of two cultivars of maize (*Zea mays*). The maize (yellow) and popcorn grains were obtained at Igbona market, Osogbo, Osun State, Nigeria.

### Methods

The popcorn and the maize grains were sorted, winnowed and ground into flour separately. Two hundred gram (200 g) of flour was weighed into sterilized conical flask and 50 ml of sterile water was added to each conical flask containing the flour to form damp composite. The mouth of each conical flask was plugged with cotton wool and covered with aluminum foil. It was allowed to ferment for 48 hrs after which the fermented flour was dried in the hot air oven at 50 °C for 18 hrs. The flour was milled and packaged in air tight container. Popcorn and maize (yellow) flours were mixed in proportion shown in Table 1.

**Table 1: Proportion of Popcorn and Maize Blends**

Sample	Popcorn (g)	Yellow maize (g)
AA	20	20
BB	25	15
CC	15	25

## ANALYSES

### Determination of Amino Acid Profile

The samples were dried to constant weight and defatted. A weight of the defatted sample was hydrolysed under vacuum with 7 mL of 6 N HCl in a sealed pyrex tube at 105°C for 22 h. Immediately after cooling, it was filtered through non-absorbent cotton wool. The filtrate was dried at 40°C using rotary evaporator. The amino acids in the flask were diluted with 5 mL of acetate buffer (pH 2.0) and 5 to 10 µL was loaded into the cartridge of Technicon Sequential Multisample Amino acid Analyzer (TSM). The absorbance of the mixture was monitored continuously in a colorimeter, the signals were magnified and traced on a two pen recorder using a linear chart to develop a chromatograph. The area under the peak was calculated as the concentration of each amino acid (Kaga *et al.*, 2002).

## RESULTS AND DISCUSSION

Table 2 showed the amino acid profile of fermented maize blends. Sample CC had higher asparagine content (8.31%), alanine (5.14 %), isoleucine (4.86%), lysine (4.87%), methionine (4.27 %) and threonine (3.24 %). Sample CC also had higher essential amino acids (35.81%) and non-essential amino acids (57.03%) than other samples. Addition of fermented popcorn flour caused reduction in the amino acid values of the flour. The flour with high percentage of yellow maize had higher amino acids. The amino acid contents of the fermented maize blends were higher than the values reported for maize meal (Adeoti *et al.*, 2012; Abiose and Ikujenlola, 2014). This signified that fermentation process greatly contributed to increase in the amino acid compositions of the fermented maize flours. Amino acid compositions are affected by species, cultivars, geographical location and the acid digestion method used in preparation of samples (Bhatty *et al.*, 2000; Wathelet, 1999). Amino acids are important components for healing and protein synthesis processes (Witte *et al.*, 2002; Zuraini *et al.*, 2006).

**Table 2: Amino Acid Profile of Fermented Maize Blends**

Amino acid	AA (%)	BB (%)	CC (%)
Asparagine %	6.78	7.28	8.31
Alanine %	4.87	3.96	5.14
Glycine %	7.18	6.96	5.88
Histidine %	3.67	3.74	3.28
Isoleucine %	4.38	4.59	4.86
Leucine %	6.92	6.69	6.77
Lysine %	3.95	4.13	4.87
Methionine %	4.11	3.86	4.27
Phenylalanine %	2.65	3.18	2.86
Proline %	1.98	2.15	1.89
Threonine %	2.89	3.07	3.24
Tryptophan %	5.74	4.92	5.66
EAA	34.31	34.18	35.81
NEAA	55.12	54.53	57.03
TAA	89.43	88.71	92.84

EAA-Essential amino acids, NEAA-Non essential amino acids, TAA-Total amino acids Amino acid scores of fermented maize blends are shown in Table 3-5. The amino acid scores for histidine which is majorly important for infant were more than 100 % in all the fermented maize blends with higher value (196.84%) in sample BB. The limiting essential amino acids in the maize blends were lysine, aromatic amino acids and threonine. The three amino acids had lower values less than 100% for children but the values were higher for adult (above 100%). Sample CC had higher isoleucine, sulphur containing amino acid, lysine and threonine contents than the other two samples. Essential amino acids that support growth and repair worn out tissue must have amino acid score greater than 100 % (Chinyere and Obasi, 2011). This showed that the amino acids of the fermented maize blends could not support growth of school age children but repair the worn out tissues in adult. Sample CC (15 g popcorn and 25 g maize flour) was considered as the best blend due to the presence of higher amino acid composition.

**Table 3: Amino Acid Score of Sample AA**

Essential amino acid	WHO Ideal protein		Amino acid concentration (g/100 g)	Percentage Amino acid score	
	Children <sup>A</sup>	Adult <sup>B</sup>		Children	Adult
Isoleucine	2.8	1.3	4.38	156.43	336.92
Leucine	6.6	1.9	6.92	104.85	364.21
Lysine	5.8	1.6	3.95	68.10	246.87
Total sulphur Amino Acid	2.5	1.7	4.11	164.40	241.76
Total aromatic amino acid	6.3	1.9	2.65	42.06	139.47
Threonine	3.4	0.9	2.89	85.00	321.11
Histidine	1.9	1.6	3.67	193.15	229.37

<sup>A</sup>WHO/FAO/UNU ideal protein for pre-school children aged 2 to 5 years; <sup>B</sup>WHO/FAO/UNU ideal protein for adult. Percentage (%) amino acid score = (amino acid in sample/ideal) × 100. Source: WHO/FAO/UNU (1985).

**Table 4: Amino Acid Score of Sample BB**

Essential amino acid	WHO Ideal protein		Amino acid concentration (g/100 g)	Percentage Amino acid score	
	Children <sup>A</sup>	Adult <sup>B</sup>		Children	Adult
Isoleucine	2.8	1.3	4.59	163.92	353.08
Leucine	6.6	1.9	6.69	101.36	352.10
Lysine	5.8	1.6	4.13	71.21	258.13
Total sulphur Amino Acid	2.5	1.7	3.86	154.40	227.06
Total aromatic amino acid	6.3	1.9	3.18	50.48	167.37
Threonine	3.4	0.9	3.07	90.29	341.11
Histidine	1.9	1.6	3.74	196.84	233.75

<sup>A</sup>WHO/FAO/UNU ideal protein for pre-school children aged 2 to 5 years; <sup>B</sup>WHO/FAO/UNU idea protein for adult. Percentage (%) amino acid score = (amino acid in sample/ideal) × 100. Source: WHO/FAO/UNU (1985).

**Table 5: Amino Acid Score of Sample CC**

Essential amino acid	WHO Ideal protein		Amino acid concentration (g/100 g)	Percentage Amino acid score	
	Children <sup>A</sup>	Adult <sup>B</sup>		Children	Adult
Isoleucine	2.8	1.3	4.86	173.57	372.85
Leucine	6.6	1.9	6.77	102.58	356.32
Lysine	5.8	1.6	4.86	83.79	303.75
Total sulphur amino Acid	2.5	1.7	4.27	170.80	251.18
Total aromatic amino acid	6.3	1.9	2.86	45.40	150.53
Threonine	3.4	0.9	3.24	95.29	360.00
Histidine	1.9	1.6	3.28	172.63	205.00

<sup>A</sup>WHO/FAO/UNU ideal protein for pre-school children aged 2 to 5 years; <sup>B</sup>WHO/FAO/UNU idea protein for adult. Percentage (%) amino acid score = (amino acid in sample/ideal) × 100. Source: WHO/FAO/UNU (1985).

## CONCLUSIONS

The research work evaluates the impact of fermentation on the amino acid profile of maize blends. Fermented maize blends were limiting in some essential amino acids (lysine, threonine and aromatic amino acids) needed for growth of infant but adequate for adult. In order to make these products useful for children, the product could be enriched or fortified with other flour containing high content of lysine, threonine and aromatic amino acid. Sample CC showed higher composition of essential amino acid needed for growth than the other two samples.

## RECOMMENDATIONS

Maize is one of the major staple foods in the world and has the largest seeds among the cereal crops. Fermentation processes improved the amino acid composition of the maize flour, therefore, more research work could be done on the fermented maize flour especially in the area of utilization. Moreover, fortification and enrichment with legumes could be done to improve the nutrient composition of the products.

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