NUTRITIONAL EVALUATION OF *Cucurbita mixta* AND *Cucurbita maxima* PULPS AND SEEDS

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Abstract
This study was undertaken to nutritionally assess pulps and seeds of Cucurbita mixta and Cucurbita maxima. Cucurbita mixta and Cucurbita maxima fruits were processed into pulps and seeds. Dietary samples consisted of (A) Basal, (B) maizeand Cucurbita mixta seed, (C) maize and Cucurbita mixta pulp, (D) maize and Cucurbita maxima seed, and (E) maize and Cucurbita maxima pulp. Thirty (30) albino rats were then reweighed and grouped into five groups of six each. The formulated complimentary foods and water were fed to experimental animals for 28 days ad libitum. The result showed that growth rate A (non protein diet) increased slightly from 53.00 to 61.30, diet B from 56.76 to 100.79, diet C from 54.20 to 87.03, diet D from 54.66 to 87.33 and diet E from 54.30 to 73.33g respectively. The average nitrogen content retained in the various organs of the experimental animals such as liver, kidney and muscle of the diets A,B,C,D and E were 45.48, 86.30, 72.80, 78.34, 65.48: 46.30, 88.56, 70.34, 78.40, 69.45.: 45.56, 85.84, 70.45, 76.50, 65.38g/100grespectively. Complimentary diet containing Cucurbita mixta seed was found superior in terms of growth rate and ensured optimum nitrogen content in the animal organs. Others followed the order: Cucurbita maxima seed, Cucurbita mixta pulp and Cucurbita maxima pulp respectively. It is thus concluded that calorieobtained from the inclusion of Cucurbita mixta and Cucurbita maxima seeds and pulps diets result in nutrient composition of complimentary foods and may be suitable to provide calorie value for sustenance, met recommended dietary allowance (RDA) and sufficient to eradicate protein energy malnutrition (PEM) in the developing Countries.

Keywords: nutritional evaluation, Cucurbita mixta, Cucurbita maxima, calorific value, pulp, seed

Received: 03.08.2017 Received in revised form: 17.11.2017 Accepted: 07.12.2017

1. INTRODUCTION

Studies in Nigeria have shown that protein energy malnutrition was the second cause of mortality and morbidity in children that were less than six years (WHO, 1998 and 2002). Adequate nutrition during infancy and early childhood is therefore fundamental to the developmental processes. The period from birth to 2 years of age is most critical for the promotion of optimal health, growth and psychological development (FAO/WHO, 1991; 1998). Dietary supplementation of various foods through exploitation of neglected or less known plant sources has been suggested to be panacea to protein energy malnutrition, a major public health problem among children throughout the developing World.

Cucurbita is one of the underutilized Crops and belongs to the family, *Cucurbitaceae*. Its existence is presently been threatened due to neglect in Nigeria; where it is cultivated at a subsistence level with virtually, no commercial importance. It is a vine crop and plays an important role in the traditional setting as a cover crop and weed control agent (Delahaut and Newenhouse, 2006). In Nigeria, it is a traditional vegetable crop grown mainly for its leaves, fruits and seeds and consumed either by boiling the leaves and fruits, or by roasting or baking the seeds (Facciola, 1990). The leaves, fruits, flowers and seeds are health promoting foods. The leaves are haematinic analgesic, and also used externally for treating burns. Traditionally, the pulp is used to relieve intestinal inflammation or enteris dyspepsia and stomach disorders (Senta and Debjanic, 2007).The fruitis an excellent source of vitamin A which supports proper growth, healthy eyes and protection from diseases. It is also rich in vitamins C and E, lycopene and dietary fiber (Pratt and Mathews, 2003; Ward, 2007).

In Africa, traditional vegetables are an important source of nutrients and Vitamins for the rural population, as many nutritional studies have shown (Mnzava *et.al*., 1999;

Mosha and Gaga, 1999). The difference between the world's supply of quality foods and the growth of the global population continues to widen and ways and means of bridging this gap have become a matter requiring an urgent attention. The current surge in the search for nutritious foods is therefore not surprising. The ultimate has not been achieved and this is evidenced by the paucity of literature available on the subject. Several plants exist with high nutritive value and yet remain unexploited for human and animal benefits (Oladele and Oshodi, 2007). In Nigeria, the populace are unawareof the high nutritional and nutraceutical values of *Cucurbita*, rather, it is regarded as traditional food mainly for the low income earners, thus has not benefited from the same level of research attention given to other vegetable crops like cucumber, fluted pumpkin etc.

Consequently, the objective of this study is to assess the nutritional quality of the pulps and seeds of *Cucurbita mixta* and *Cucurbita maxima* formulated into complementary foods that will meet the recommended dietary allowance (RDA).

2. MATERIALS AND METHODS

2.1. Materials for Dietary Composition

Curcurbita mixta and *Cucurbita maxima* fruits harvested from Ponpola village, in Ede South Local Government Area of Osun State, cultivated by the first Author for research purposes were processed into pulps and seeds. They were subsequently sundried until constant weights were obtained. The dried samples were thereafter milled into flour samples prior to reconstitution into complementary diets for experimental animals. The maize grains used as 100% carbohydrate source were obtained from a local market in Ile-Ife. The maize was also processed into a powdery form prior to constitution into diets. The diets were constituted as follows:

(A) 100% maize (non protein diet);
(B) 80% maize and 20% *Cucurbita mixta* Seed;
(C) 80% maize and 20% *Cucurbita mixta* Pulp;
(D) 80% maize and 20% *Cucurbita maxima* Seed;
(E) 80% maize and 20% *Cucurbita maxima* Pulp
(Ikujenlola and Fashakin, 2005;Fashakin and Ogunsola, 1982; Fashakin *et.al*., 1989).

2.2. Animal Experiment

Thirty (30) weaning albino rats of both sexes obtained from Faculty of Pharmacy Animal Breeding Centre, Obafemi Awolowo University, Ile-Ife, Nigeria were weighed and randomly allocated into metabolic cages. Their weights and ages were ranged from 54.20 to 56.76 g and 5 to 6 weeks old respectively. The animals were allocated into metabolic cages, each of which was pre-fixed with a cup and a small plastic bottle in order to supply food and water *ad libitum*. The animals were acclimatized to the laboratory environment by feeding them on normal diets for seven days. The animals were then reweighed and grouped into five groups of six rats each. Daily consumption of dietary samples was carefully recorded and the weights were noted for 28 days. Variations in weight of the experimental animals were taken every three days. Seven days to the end of the experiment, the faeces and urine of the experimental animals in the different groups were collected separately. Urine was stored inside a bottle per group, containing 6N HCL to preserve it prior to analysis and the faeces were dried in an oven at 60^{o}C for 12 hours, cooled, weighed and stored inside a sealed polythene, per group. At the end of the experiment, the experimental animals were sacrificed. Organs like kidney, liver and muscle of the hind leg were obtained, weighed and stored frozen at -10^{o}Cprior to nitrogen determination by the Micro kjeldah method. (Ibironke *et. al*., 2012; AOAC, 2000 and Fashakin *et.al*., 1986.

3. ETHICAL CONSIDERATION

This study was approved by the Ethical Review Committee of the Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.

Table 1: Growth response of the experimental animals fed with maxima and mixta seeds and pulp dietary for 28 days

Experiment Group	1	4	7	10	13	16	19	22	25	28	Weight gain/Loss
C. maxima seeds	54.66	57.23	59.17	58.23	59.07	58.90	61.23	77.33	78.40	87.33	32.67
C. mixta seeds	56.76	66.56	67.90	66.57	70.62	66.63	67.43	85.40	93.63	100.79	44.02
C. maxima Pulp	54.30	63.40	60.37	56.30	56.47	53.23	52.10	64.06	68.90	73.33	19.02
C. mixta pulp	54.20	62.13	63.70	62.40	69.43	62.30	62.07	74.23	81.0	87.03	32.82
Basal	55.00	63.33	58.20	58.87	61.90	55.60	58.57	63.03	61.77	61.30	6.30

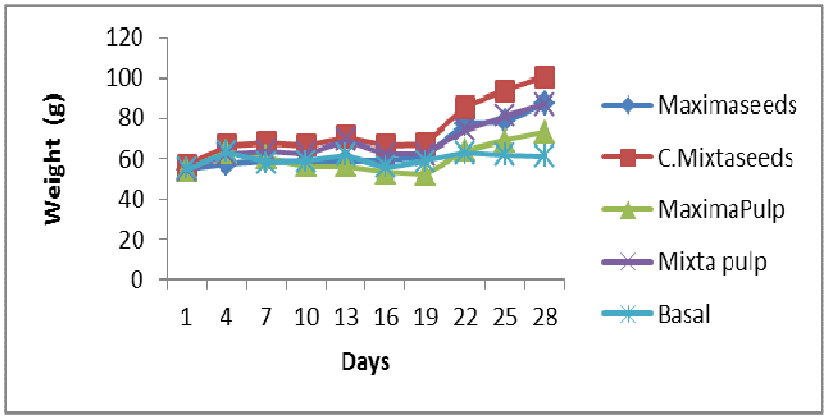

Figure 1: Growth response of the experimental animals during 28 days

4. RESULTS AND DISCUSSION

Table 1 highlights the weight gain over the 28 days experimental period for *Cucurbitamaxima* and *Cucurbitamixta* seeds as well as their pulps and basal diets respectively. Theobserved variations may be attributed to adequate nutrition and appropriate formulation of the diets which ultimately affects the nutrient intake in terms of quality and quantity.

Figures 1 and 2 showed the growth rate and response to dietary intake of the experimental animals during 28 days. The growth response was highest in diet with *Cucurbita mixta* seeds, followed by the diet with *Cucurbitamixta* Pulp. Next was the diet with *Cucurbita maxima* seeds and *Cucurbita maxima* Pulp respectively. The basal diet (100% maize) which is a non-protein diet recorded the least growth response/ performance among all the diets. Order of growth response performance is an indication of complete amino acid profile in the *Cucurbita mixta* and *Cucurbita maxima* seeds and pulps incorporated into the diets. The basal diet lacked adequate nutrient such as protein, thereby deficient in essential amino acids required to support growth.

This diet was therefore not nutritionally adequate to enhance growth (Ibironke *et.al*., 2012; 2014a b c).

Table 2 presents the various internal organs of the experimental animals such as livers, kidneys and selected muscles which ranged from 2.9 to 4.5, 0.63 to 1.0 and 0.52 to 0.56 respectively.

On the other hand, it was observed that the weights of the animals dictated the size of the organs obtained from the experimental animals: the higher the animal weight the higher the organ weight (Ibironke *etal*, 2012 and Fashakin *et.al*., 1986).

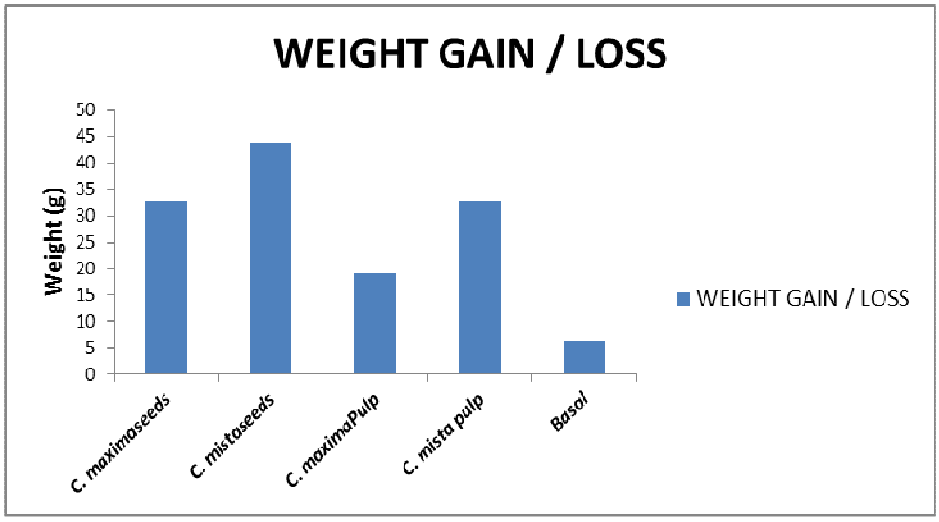

Figure2: Weight gain/loss of the experimental animals during 28days

Table 2: Average weight in grams of various organs of the experimental animals

Experiment Group	Liver	Kidney	Muscle
C. maxima seeds	4.20	0.96	0.54
C. mixta seeds	4.50	0.90	0.56
C. maxima Pulp	2.90	0.70	0.52
C. mixta pulp	3.40	1.00	0.56
Basal	3.10	0.63	0.55

Table3: The average Nitrogen retained in various tissues of experimental animals

Experiment Group	Liver	Kidney	Muscle	Fecal	Urine
C. maxima seeds	78.34	78.40	76.50	0.22	0.24
C. mixta seeds	86.30	88.56	85.84	0.22	0.25
C.maxima Pulp	65.48	65.45	65.38	0.21	0.21
C. mixta pulp	72.80	70.34	70.45	0.24	0.23
Basal	45.48	46.30	45.56	0.45	0.55

Table 3 outlines the average nitrogen contents retained in various organs of the experimental animals which include the liver, kidney and muscle. The tissue nitrogens are general reflection of dietary nitrogen content level. The contents retained in experimental animal faeces and urine are also presented. The average nitrogen retained in diets containing *C. mixta* and C. *maxima* seeds and pulps organs of experimental animals were similar. However, the highest retention of nitrogen was found in experimental animals fed with *C. mixta* seeds. This was followed by others fed with *C. maxima*seeds;*C. mixta* pulp and *C. maxima* pulp respectively; while the average nitrogen content retained in the basal diet (non protein diet) organs of experimental animals was the lowest. It could therefore be deduced that diets containing *C. mixta* and *C. maxima* seeds and pulps have enough nutrients which could be retained by experimental animals' muscles. This may be due to the fact that the amino acid profiles are complete and that diets can liberate more nitrogen that is sufficient to supply to the body organs (Ibironke *et.al*., 2012; Uauy and Castillo,2003; Young *et. al*., 1998).

In addition, apart from the fact that the contents retained in the experimental animals faeces and urine were highly negligible for all the diets, those associated with the basal diet were even found to be far greater than those with the C. *mixta* and *C. maxima* seeds and pulps. This is an indication that nitrogen was poorly absorbed in the faeces and urine (waste products) of the experimental animals.

Table4: Biological assay of the experimental animal

Diet	NPR	PER	NPU	BV	FER	Weight gain/loss (g)
C. maxima seeds	2.63	3.26	76	85	0.326	32.67
C. mixta seeds	3.69	4.39	78	89	0.439	44.02
C. maxima Pulp	1.273	1.903	70	79	0.903	19.02
C. mixta pulp	2.65	3.28	75	76	0.328	32.82
Basal	-		-	-	-	6.3

Table 4 shows the protein qualities of dietary samples including net protein ratio (NPR), protein efficiency ratio (PER), net protein utilization (NPU), biological value (BV) and feed efficiency ratio (FER). They ranged from 1.273 to 3.69; 1.903 to 4.39; 70 to 78; 76 to 89 and 0.326 to 0.903 respectively.

The PER of the diet containing *maxima* pulp slightly fell below the standard of 2.1 while all others met the required standard of 2.1 and this corroborated the previous findings that PER was influenced by weight gained and source of nitrogen (PAG, 2007; Obizoba, 1990). The results obtained for PER and NPR compared favorably with what had been observed previously. The requirement value for NPU of 60 per cent was met by all the diets and this is in agreement with what others had reported (PAG,2007;Ikuenlola and Fashakin, 2005). The basal diet has no biological value because it contains no protein, and it is deficient in amino acids, hence could not support growth (Lutter, 2000; Ibironke *et.al*., 2012; 2014 abc).

5. CONCLUSIONS

This study has revealed that the diet containing *Cucurbita mixta* seeds was found to be superior in terms of growth rate, protein efficiency ratio (PER), net protein ratio (NPR) and net protein utilization (NPU) as well as optimum nitrogen content in the liver, kidney and tissues. *Cucurbita mixta* seed was followed by *Cucurbit amaxima* seed, *Cucurbita mixta* pulp and *Cucurbita maxima* pulp respectively.

Consequently, *Cucurbita mixta* and *Cucurbita maxima* seeds and pulps are vegetable sources of proteins capable of supporting formulation of complementary foods, thereby useful in the reduction of protein energy malnutrition in the developing countries.

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