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# Proximate Composition, Selected Mineral, Physical Characteristics and *in vitro* Multienzyme Digestibility of Cucumber (*Cucumis sativus*) Fruit from Nigeria

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**Abstract:** The proximate composition, mineral, physical characteristics and *in vitro* digestibilities of cucumber (*Cucumis sativus*) were determined using standard methods of analysis. The results revealed that the mesocarp, epicarp and endocarp of the cucumber contained: 1.68, 3.84 and 0.22% of protein, respectively. The relative fat content varied from a low of 0.02% in endocarp to a high of 0.56% in epicarp, moisture and ash contents were comparable with values of literatures cited. As expected macro minerals were higher than the micro minerals. Na had the highest value followed by Mg, K and Ca. Pb was not detected. *In vitro* digestibilities of the samples were determined for 10 min. Percentage digestibilities varied thus: epicarp (68.5) mesocarp (78.2) and endocarp (80.5). From the obtained results, it was observed that epicarp of the sample had higher values for ash, protein, fat, fiber and carbohydrate than mesocarp and epicarp. It is hoped that these results would add to existing nutrition data.

**Key words:** *Cucumis sativus*, mesocarp, epicarp, endocarp, *in vitro* digestibility

## INTRODUCTION

*Cucumis sativus* a member of Cucurbitaceae originated from South Asia. They are generally grown in Caribbean, Malaysia, Indonesia, West Africa and tropics generally. It is eaten raw or cooked, sometimes pickled. Leaves, fruits and stems are edible (Tindall, 1967).

Over the past 30 years, Chinese cucumber breeders have produced approximately 40 and $F_1$ hybrid cultivars, which occupy 40% of the cucumber production area in China (Cui and Zhang, 1991). Breeders world wide continue to select for a wide range of desirable characteristics, in addition to disease and pest resistance. Cultivars have been bred for tolerance to cold, heat, drought, herbicides, sulphur dioxide and soil salinity (Robinson and Decker-Walters, 1991).

Studies have been carried out on the comparative food qualities of *Cucumis sativus* (Tindall, 1967; Robinson and Decker-Walters, 1991), but there is dearth of information on the *in vitro* multienzyme digestibility of protein of this sample. The determination of digestibility of cucumber would provide a satisfactory index of its protein utilization. Digestibility of protein and bioavailability of constituents amino acids are important factors in food utilization (FAO/WHO, 1990).

The aim of this report was to deal with chemical composition and the *in vitro* mutltienzyme protein digestibility of cucumber. It is hoped that these results would add to existing knowledge on this fruit.

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## MATERIALS AND METHODS

Cucumber (*Cucumis sativus*) used for this analysis were obtained from a supermarket in Ile-Ife, Osun State, Nigeria in March 2005. They were washed in distilled water, dried between fitter paper, separated into epicarp, mesocarp and endocarp using a knife. The separated parts were over dried at 60°C, ground in a Kenwood blender, sieved (45 mm wire mesh) and stored in airtight plastic containers.

The proximate analysis of the samples for fat, fiber, ash and moisture were carried out using the methods described by AOAC. (1990). Nitrogen was determined by the micro-Kjeldahl method described by Pearson (1976) and the nitrogen content was converted to protein by multiplying by 6.25. Carbohydrate was obtained by subtracting the total values of ash, fiber, fat and moisture from 100. Energy value was obtained by using the methods of Abulude and Folorunso (2003).

Minerals were analyzed from solutions obtained by dry ashing the samples at 550°C in a muffle furnace and dissolving them in distilled water containing few drops of concentrated hydrochloric acid in volumetric flasks. Na and K were determined by means of flame photometer (Corning, UK, Model 405) while other elements were determined using atomic absorption spectrophotometer (Pye Unicam SP 9, Cambridge, UK),

*In vitro* digestibility was carried out using the method of Hsu *et al*. (1977). Fifty milliliters of an aqueous suspension of the sample (6.25 mg, sample per mL) in distilled water was adjusted to pH 8.0 with O.IM HCL and or O.IM NaOH, while stirring in a 37°C water bath. The multienzyme solution consisting of 1.6 mg trypsin, 3.1 mg chymotrypsin and 1.3 mg peptidase per mL was maintained in an ice bath and adjusted to pH 8.0 with O.IM HCL or O.IM NaOH. A 5 mL sample of the multienzyme solution was added to the sample suspension with constant stirring at 37°C. The pH of suspension was recorded at 10 min after the addition of the multienzyme solution and the *in vitro* digestibility was calculated using the regression equation of Hsu *et al*. (1977):

$$Y = 210.46 - 18.10X$$

Where, Y is *in vitro* digestibility, X is the pH of sample suspension after 10 min digestion with the multienzyme solution. Sample suspensions were also prepared as above, heated to boiling point and allowed to boil for 10 min, as descended by Grant *et al*. (1983), cooled and incubated at 37°C. The digestibilties of these samples were determined using the multienzyme solution as described above. The multienzyme solution was freshly prepared before each series of tests and its activity was determined using a casein of known *in vivo* apparent digestibility (Hsu *et al*., 1977).

All analyses were determined in triplicate and data generated were statistically analyzed (mean, standard error and coefficient of variation in percent (CV %)).

## RESULTS AND DISCUSSION

The Protein content of epicarp (3.84%), mesocarp (1.68%) and endocarp (0.22%) were lower than those reported for Baobab fruit (Odetokun, 1996), fruits of *Pyrus commnis*, *Irvingia gabonensis* and *Mangifera indica* (Adeyeye and Arogunjo, 1997), *Chrysophyllum albidum*, *Malus pumila* and *Psidium guajava* fruits (Adeyeye and Agesin, 1999) and Mulberry leaves (Bamikole *et al*., 2005). The relative fat content varied from epicarp to endocarp. The values ranged from a low of 0.02% endocarp to a high of 0.56% for epicarp. According to fat content the three parts can be considered as a low fat category. The low fat content will not allow this fruit to contribute significantly as a source of non- visible oil to the diet in which it may be present (Table 1). Moisture (35.35-95.23%) and ash (0.05-3.65%) levels were within the range covered by Abulude *et al*. (2004) for some tree barks and Williams and Badrie (2005) for boiled breadnut seeds. It could be noted that the proximate composition

Table 1: Proximate composition (100 $g^{-1}$) of the cucumber analyzed (dry matter)

| Parameters | Epicarp | Mesocarp | Endocarp | Mean | Std error | CV (%) |
|---|---|---|---|---|---|---|
| Ash | 3.65 | 0.23 | 0.05 | 1.31 | 2.03 | 154.85 |
| Protein | 3.84 | 1.68 | 0.22 | 1.91 | 1.82 | 95.19 |
| Fat | 0.56 | 0.10 | 0.02 | 0.23 | 0.29 | 128.57 |
| Moisture | 35.35 | 89.28 | 95.23 | 73.29 | 32.99 | 45.01 |
| Fiber | 49.07 | 7.52 | 4.48 | 20.36 | 24.91 | 122.38 |
| Carbohydrate | 7.53 | 1.20 | ND | 4.37 | 4.48 | 102.54 |
| Energy | 50.52 | 12.42 | 1.06 | 21.33 | 25.91 | 121.44 |

Table 2: Mineral composition (mg $kg^{-1}$) of the cucumber analyzed (dry matter)

| Parameters | Epicarp | Mesocarp | Endocarp | Mean | Std error | CV(%) |
|---|---|---|---|---|---|---|
| Mg | 693 | 660 | 629 | 659.3 | 34.00 | 5.16 |
| Zn | 21 | 17 | 15 | 17.7 | 3.16 | 17.29 |
| Fe | 142 | 129 | 113 | 128.0 | 14.53 | 11.35 |
| Ca | 660 | 630 | 551 | 613.7 | 56.30 | 9.18 |
| K | 677 | 590 | 701 | 656.0 | 58.40 | 8.90 |
| Na | 710 | 754 | 636 | 700.0 | 59.63 | 8.52 |
| Mn | 28 | 14 | 12 | 18.0 | 8.72 | 48.43 |
| Cu | 38 | 6.0 | 4.1 | 16.0 | 19.05 | 118.80 |
| Pb | ND | ND | ND | - | - | - |

ND: Not Detected

of all samples compared with our results, varied according to the season, geographical location of harvest and size. Carbohydrate content of these samples was calculated as the difference between 100 and the total percent of moisture, protein, fat and ash. The energy value of the different portions is also shown in Table 1. The low energy values could be due to high water content of the samples. The CV (%) was high in most of the parameter, but low in moisture content (45.01%). There were significant differences among the samples. In comparison of the epicarp and other parts of the sample showed that epicarp had higher values for ash, protein, fat, fiber, carbohydrate and energy while others were more concentrated in moisture content. The CV (%) for each parameter was high in the sample, but for moisture content, it was below 50%. This means it was in moisture content that low disparity occurred between the samples. This revelation depicted that the endocarp and mesocarp were prone to spoilage due to availability of water for bacterial activities. The ash content depicted that epicarp may be more concentrated in minerals than other parts.

The element contents of the samples are shown in Table 2. Zn an essential element for human metabolism (Anhwange *et al*., 2005) was present in the amount ranging from 15 mg $kg^{-1}$ in endocarp to 21 mg $kg^{-1}$ in epicarp. These observations suggest that the samples could provide a significant portion of the Nigerian food Administration for Zn, if consumed regularly. The Fe content ranged from 113 mg $kg^{-1}$ in endocarp to 142 mg $kg^{-1}$ in endocarp. Cu levels were between 4.1 mg $kg^{-1}$ in endocarp and 28 mg $kg^{-1}$ in endocarp. ND was recorded for Pb. The rest of the elements were available in Lange amounts when the amounts of these elements were compared with the literature values. These samples can be considered as good sources of Zn, Fe and other elements in study. The CV (%) for each parameter was low in the sample, but for Cu, it was above 100%. This means it was in Cu that high disparity occurred between the samples.

It is worthy to note that Ca in conjunction with Mg, P, Mn, vitamin, chlorine and proteins are involved in the formation of bone (Abulude, 2001) It also plays an important role in blood clotting, coordination of inorganic elements present in the body and balancing of Ca and P. It is very important that the normal Ca levels in the diet should be balanced throughout life. Increasing dietary K has lowered blood pressure in humans, which by itself should reduce the risk of stroke, however, some of the protective effect of K appears to extend beyond its ability to lower blood pressure. Maintaining a high K intake may be achieved by consuming cucumber. It is gratifying to note the non detection of Pb because its presence in the environment and food is known to be hazardous.

Table 3: *In vitro* protein digestibility (%) of cucumber analyzed (dry matter)

| Samples | Digestibility |
|---|---|
| Epicarp | 68.5 |
| Mesocarp | 78.2 |
| Endocarp | 80.5 |
| Mean | 75.7 |
| Std. Error | 6.37 |
| CV(%) | 8.41 |

Table 4: Physical characteristics of cucumber analyzed

| Parameter | Range | Mean (Std. Error) |
|---|---|---|
| Color | Green with white streaks | |
| Weight (g) | 20-40 | 28 (0.3) |
| Length (cm) | 40-75 | 55 (0.4) |
| Shape | Oval with pointed ends | |
| Epicarp (g) | 6-10 | 8 (0.05) |
| Mesocarp (g) | 10-21 | 16 (0.2) |
| Endocarp (g) | 4-9 | 7 (0.05) |

Mn is known for normal bone metabolism and important enzyme reactions, maintenance of normal nerve, brain and thyroid functions. Its deficiency is uncommon but can affect brain, glucose tolerance, normal reproduction, skeletal and cartilage formation (Wasantwisut, 1997; Keen *et al*., 1999). Zn supports the health of the immune system, normal synthesis of protein and the health of reproductive organs (especially in men) the deficiency of Zn adversely affect normal physical growth, skin nerve health, natural healing ability and immune function especially in infant (Schauss, 1995; Sandstead, 1995). Cu is necessary for blood nerves, joints, heart, skin, liver and the immune systems. It is also critical to the absorption and utilization of both Zn and Fe (Jones *et al*., 1997). The inability to produce important antioxidant enzymes and shortage of red blood cell has been implicated by Cu deficiency and excess Cu in the diet depress retention and utilization of Zn (Reddy and Love, 1999), about 1-10% of plant Fe is said to be absorbed by the body. Although this absorbance can be improved by the presence of animal Fe (Bender, 1992).

Table 3 shows the *in vitro* protein digestibility of the mesocarp, epicarp and endocarp of the sample. The digestibility of mesocarp was 78.2%, epicarp 68.5% and endocarp 80.5% with CV(%) of 8.41. Our results were comparable to the results for maize-tilapia flour blends (69.3-83.7%; Fasasi *et al*., 2005), African yam bean (71.89-88.00%; Oshodi *et al*., 1995) and some tropical plant seeds (56.25-78.10%; Abulude, 2005), but lower than 94.12-101-49% recoded for some legume seeds (Egwaikhide *et al*., 2005). The difference between our current results and those of Egwaikhide *et al*. (2005) might arise from the differences in sample origin, cultivars, fortification of blends and processing methods. The poor digestibility of protein in the diets of developing countries appears to be due to the use of less- refined cereals and pulses as major sources of protein (FAO/WHO, 1990).

Efforts are however, being made to improve the digestibility of pulses in the developing countries through long cooking, soaking, dehulling, fermentation and moist heat-treatment.

Differences in protein digestibility may arise from inherent differences in the nature of food protein, from the presence of non-protein constituents, which may modify digestion, from the presence of antiphysiological factors or from processing conditions that alter the release of amino acids from proteins by enzymatic processes (FAO/WHO, 1990).

The mean weight (Table 4) of the sample was 28 (0.3 g). Mesocarp was heavier with mean weight of 16 (0.2 g). The length was between 40 and 75 g, as expected the shape was oval with pointed ends, this was due to the physiological compositions.

## CONCLUSIONS

Epicarp, endocarp and mesocarp of *Cucumis sativus* contained some levels of protein, fiber and carbohydrate. It is gratifying to note that the samples had no Pb level which is known to be toxic, but contained valuable minerals needed for the proper functioning of the consumer, however, all the sample parts had high protein digestibility. This showed that the digestibilities would provide satisfactory index of protein utilization of the sample.

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