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Proximate composition of the selected new yam cultivars

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ABSTRACT

Proximate composition of the selected new yam cultivars were analysed. The new white yam cultivars used for this study were obtained from African yam barn at Faculty of Agriculture and Natural Resources Management, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria. The new yam tubers were sorted, washed, peeled and sliced with stainless steel knife into 1mm thickness. The slices were soaked in 200 ppm sodium metabisulphate solutions for 10 minutes, drained, and was dried at 60 °C for 48 hours using an oven. It was dry milled into powder using marlex blender (electro line model IS 4780, CM/L 7902804) to obtain the flours. The flours were kept in a high density polyethene bags (HDPE) film and kept in a refrigerator until ready for use. Proximate analyses were done using standard methods. The protein content of the new yam cultivars ranged from 4.76% for flour samples MECC9 RU59 to 6.97 % for flour sample TDR0500491, flour sample MECC9RU 59 had the lowest value of 4.76 %, while flour sample TDR 0500491 had the highest value of 6.97 % for protein content in the column. Statistics showed that significant difference ($P<0.05$) exist amongst the flour samples for protein content, except for flour samples TDR1100585 and REP1 BED 19 which are not significantly ($P>0.05$) different from each other. The moisture contents of the new yam cultivars in Table 1 showed that the moisture content ranged from 10.08% for sample TDR 1100492 to 10.67 % for sample REP1 BED 19. Flour sample TDR 1100492 had the lowest value of 10.08 %, while flour sample REP1 BED 19 had the highest value of 10.67 %. Significant difference ($P<0.05$) exist for the flour samples in Table 1 for moisture contents. Ash content gives an indication of minerals present in a particular food sample and it is very important in many biochemical reactions which aid physiological functioning of major metabolic processes in the human body [9]. The ash contents of the flour sample ranged from 2.03 % for sample REP1 BED8 to 2.43 % for sample TDR0900082. Significant difference ($P<0.05$) exists amongst the flour samples for ash content. Flour sample REP1 BED8 had the lowest value of 2.03 %, while flour sample TDR0900082 had the highest value of 2.43 % for the ash content. In conclusion, the results from this research indicated that the new yam cultivars are rich in protein and ash contents.

Keywords: Proximate composition of the selected new yam cultivars.

INTRODUCTION

Many people in the developing nations depend on root and tuber crops as a principal source of food nutrition and income [1,2,3]. Yam is a seasonal crop and most available during its harvesting period, but scarce and expensive during its planting and growing season[4,4,5,6]. The storage life of yam is however, limited to the dormancy period after which they begin to sprout and quickly lose their dietary value. Yam is a rich source of carbohydrates and also contributes to vitamins and minerals especially where it is consumed in large quantities [7,8,9,10]. In West Africa there are many cultivars of yam and more than 95% of the world's yam is produced in Africa with the remainder grown in the West Indies, part of Asia, South and Central America [11,12,13,14,15]. Yam is the oldest recorded food crops second after cassava in supply of starch in West Africa [16,17,18,19]. In West Africa, a major proportion of yam is eaten as boiled yam, roasted yam, fried yam, and pounded yam. The most processed traditional yam product is yam flour [20] which contains carbohydrates and trace amounts of minerals and vitamins. The flour is used in making a thick paste by stirring it in boiling water to yam fufu, which is eaten with soup [20]. The flesh of yam specie usually used is white, the colour of the processed flour ranges from cream-white to dark brown. This discoloration phenomenon has long been studied in fresh yam tubers and has mainly been associated with enzymatic browning due to the action of polyphenoloxidase [21]. The problem of inadequate food supply in sub-saharan Africa and the attendant malnutrition problem [22,23,24] necessitated researches aimed at finding alternative food supply from available but less utilized food sources [25,26].

Objective

The objective of this study is to evaluate the proximate composition properties of the selected new yam cultivars.

MATERIALS AND METHODS

Source of raw materials

The new white yam cultivars used for this study were obtained from African yam barn at Faculty of Agriculture and Natural Resources Management, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria.

The new yam cultivars includes

- **i. REP1 BED8**
- **ii. TDR 1100585**
- **iii. MECC8 RU59**
- **iv. REP1 BED4**
- **v. TDR00396**
- **vi. TDR1100492**
- **vii. TDR0500491**
- **viii. REP1 BED19**
- **ix. TDR0900082**
- **x. TDR0900002**

Sample preparation

Production of yam flour

The new yam tubers were sorted, washed, peeled and sliced with stainless steel knife into 1mm thickness as described by [23]. The slices were soaked in 200 ppm sodium metabisulphate solutions for 10 minutes, drained, and was dried at 60 °C for 48 hours using an oven. It was dry milled into powder using marlex blender (electro line model IS 4780, CM/L 7902804) to obtain the flours. The flours were kept in a high density polyethene bags (HDPE) film and kept in a refrigerator until ready for use.

1. TDR 00396

2. REPI BED4




2. MECC9 RU 59 4. TDR0900002 5. TDR0900082 6.REPI BED8




7. TDR0500491 8.TDR1100585 9.REPI BED19 10.TDR1100492

Plate 1:The selected new yam cultivars

Plate 3: The yam flour

Plate 2: The sliced yam chips

Fresh new yam tubers

↓

Peeling

↓

Washing

↓

Slicing

↓

Soaking (in 1 % Sodium Metabisulphite for 10 min)

↓

Drying (60 °C for 48hrs)

↓

Milling

↓

Yam flour

↓

Packaging in (high density polyethene bags) HDP

Fig 3: Flow chart for the production of Yam flour

Proximate Composition Analysis

Moisture content determination

The Moisture Content was determined using the method described by [2] described below; two grams of each sample were weighed into dried weighed crucibles. The samples were put into a moisture extraction oven (Gallenkamp) at 105 oC for 3 hrs. The dried samples were then placed inside desiccators, allowed to cool and reweighed. The processes were repeated until constant weight is obtained. The moisture content of the sample was calculated usingequation;

$$\text{Moisture content (\%)} = \frac{W2-W1}{W2-W1} \times 100$$

Where: W_1 = initial weight of empty crucible (g)
W_2 = weight of dish + undried sample (g)
W_3 = weight of dish + dried sample (g)

Ash determination

The method described by [2] was used to determine the ash content. Two grams of finely ground sample was weighed into a preheated cooled crucible and charred on a bunsen flame inside a fume cupboard. The sample was transferred into a preheated muffle furnace at 90°C for 3 hrs until a white or light grey ash is obtained after which it was cooled in a desiccators and weighed. The ash content was calculated as in equation below;

$$\text{Ash (\%)} = \frac{W2-W3}{W2-W1} \times 100$$

Where:
W_1 = weight of empty crucible (g)
W_2 = weight of crucible (g) + sample before ashing (g)
W_3 = weight of crucible (g) + sample after ashing (g).

Crude protein determination

The protein content of the samples were determined according to the standard method of [1] using the Kjeldahl method described below.

Digestion of sample

Two grammes sample was weighed into Kjeldahl flask. About 5g anhydrous sodium sulphate was added. Twenty five milliliter (25 ml) conc. H_2SO_4 was added with few boiling chips and heated in the fume chamber until solution becomes clear. The solution was cooled to room temperature after which it was transferred into a 250 ml volumetric flask and made up to the level with distilled water.

Distillation

The distillation unit was cleaned and the apparatus set up. A 100 ml conical flask, (receiving flask) containing 5 ml of 2 % boric acid was placed under the condenser with addition of drops of methyl red indicator. Five milliliter of the digest was pipetted into the apparatus through the small funnel, which was washed down with distilled water followed by addition of 5 ml of 40 % sodium hydroxide solution. The solution in the receiving flask was titrated with 0.049 M H_2SO_4 to obtain a pink color. The percentage crude protein was calculated using equations below;

$$\text{Nitrogen in sample (\%)} = \frac{(\text{Titer} - \text{Blank}) \times \text{Normality of acid} \times N_2 \text{ factor } (1.4) \times 100}{\text{Weight of sample}}$$

$$\text{Crude protein (\%)} = \text{Nitrogen in sample (\%)} \times 6.25$$

Fat determination

The Soxhlet extraction method of [1] was applied. A Soxhlet extractor with a reflux condenser and a 500 ml round bottom flasks was fitted and two grammes of the sample was weighed into a labeled thimble. Petroleum ether (300 ml) was filled into the round bottom flask and the extractor thimble sealed with cotton wool. The Soxhlet apparatus was allowed to reflux for 6 hrs after which the thimble was removed with care and petroleum ether collected at the top and drained into a container for reuse. When the flask swill be free of ether, it was removed and dried at 105 °C for 1 hr in an oven (Gallenkamp), cooled in a desiccator and weighed. The fat content in percent shall be calculated using equation below;

$$\text{Fat (\%)} = \frac{\text{Weight of Fat (g)}}{\text{Weight of sample (g)}} \times 100$$

Crude fibre determination

The crude fibre content of the samples was determined according to the method described by [2] procedure. Petroleum ether was used to de-fat 2 g of the sample which was placed in preheated 200 ml of 1.25 % H_2SO_4 and boiled for 30 minutes. The solution was filtered through linen or muslin cloth on a fluted funnel after which it was washed with boiled water until free of acid. The residue was returned into 200ml boiling NaOH and allowed to boil for 30 minutes. It was further washed with 1 % HCl boiling water, to free it of acid. The final residue was drained and transferred to silica ash crucible (porcelain crucible) and dried in oven to a constant weight. The dried crucible was removed, cooled and weighed. The difference in weight was recorded and expressed as percentage crude fibre as in equation below;

$$\text{Crude fibre (\%)} = \frac{W_1 - W_2}{W_3} \times 100$$

Where
W_1 =Weight of sample before incineration (g)
W_2 = Weight of sample after incineration (g)
W_3 = Weight of original sample (g)

Determination of Carbohydrate

Carbohydrate content of the samples was determined by the difference using; Carbohydrate (%) = 100 – (moisture % + ash % + % protein % + crude fiber % + crude fat %)

Total energy value

The total energy value was determined according to the method of [8], using equation below. Total energy = [(Carbohydrates % × 4) + (protein % × 4) + (fat % × 9)]

RESULTS

Proximate composition of the new yam cultivars

The proximate composition of the new yam cultivars flours are presented in Table 1.

The protein content of the new yam cultivars ranged from 4.76% for flour samples MECC9 RU59 to 6.97 % for flour sample TDR0500491, flour sample MECC9RU 59 had the lowest value of 4.76 %, while flour sample TDR 0500491 had the highest value of 6.97 % for protein content in the column. Statistics showed that significant difference (P<0.05) exist amongst the flour samples for protein content, except for flour samples TDR1100585 and REP1 BED 19 which are not significantly (P>0.05) different from each other. The moisture contents of the new yam cultivars in Table 1 showed that the moisture content ranged from 10.08% for sample TDR 1100492 to 10.67 % for sample REP1 BED 19. Flour sample TDR 1100492 had the lowest value of 10.08 %, while flour sample REP1 BED 19 had the highest value of 10.67 %. Significant difference (P<0.05) exist for the flour samples in Table 1 for moisture contents. Ash content gives an indication of minerals present in a particular food sample and it is very important in many biochemical reactions which aid physiological functioning of major metabolic processes in the human body [9]. The ash contents of the flour sample ranged from 2.03 % for sample REP1 BED8 to 2.43 % for sample TDR0900082. Significant difference (P<0.05) exists amongst the flour samples for ash content. Flour sample REP1 BED8 had the lowest value of 2.03 %, while flour sample TDR0900082 had the highest value of 2.43 % for the ash content.

Table 1: Proximate Composition of selected new yam cultivars

Sample	Moisture (%)	Crude Fibre (%)	Ash (%)	Protein (%)	CHO (%)	Fat (%)	T.Energy Kcal/100g
REP I BED8	10.24^{h}±0.01	1.69^{d}±0.01	2.03^{i}±0.01	6.36^{d}±0.01	80.80^{e}±0.01	0.58^{a}±0.001	381.70^{abc}±2.5
TDR 1100585	10.27^{g}±0.01	1.58^{e}±0.01	2.15^{g}±0.01	5.97^{f}±0.01	81.16^{d}±0.01	0.46^{d}±0.001	376.70^{cd}±2.4
MECC9RU59	10.48^{c}±0.01	1.75^{c}±0.01	2.18^{f}±0.01	4.76^{i}±0.01	82.20^{a}±0.01	0.40^{f}±0.001	378.50^{bcd}±3.5
REP I BED4	10.36^{e}±0.01	1.67^{d}±0.01	2.36^{c}±0.01	6.68^{b} ±0.01	80.20^{h}±0.01	0.41^{e}±0.001	368.60^{e}±0.78
TDR 00396	10.56^{b}±0.01	1.59^{e}±0.01	2.09^{h}±0.01	6.28^{e}±0.01	80.61^{g}±0.00	0.48^{b}±0.001	376.60^{cd}±0.64
TDR 1100492	10.08^{i}±0.01	1.45^{f}±0.01	2.19^{f}±0.01	5.86^{g}±0.01	81.50^{b}±0.01	0.39^{g}±0.001	382.45^{ab}±R0.50
TDR 0500491	10.34^{f}±0.01	1.86a±0.01	2.25^{e}±0.01	6.97^{a}±0.01	79.99^{j}±0.01	0.46^{c}±0.001	381.35^{abc}±0.78
REP I BED 19	10.67^{a}±0.01	1.79^{b}±0.01	2.34^{d}±0.01	5.96^{f}±0.01	80.67^{f}±0.04	0.38^{h}±0.001	375.45^{d}±0.35
TDR 0900082	10.45^{d}±0.01	1.67^{d}±0.01	2.43^{a}±0.01	6.65^{c}±0.01	80.13^{i}±0.01	0.36^{i}±0.001	386.60^{a}±0.78
TDR 0900002	10.29^{g}±0.01	1.47f±0.01	2.39^{b}±0.01	5.76^{h}±0.01	81.24^{c}±0.02	0.34^{j}±0.001	381.60^{abc}±0.78

Data are expressed as mean ± standard deviation (SD). Values are means of two replicate determination, Sum Mean values in the same column with Superscripts are not significantly (P>0.05) different. CHO: Carbohydrate; T. Energy: Total energy.

Carbohydrates values in all the flour samples of the new yam cultivars were more than 70 % in values. It affirms the fact that Yams are a valuable source of dietary carbohydrates. Although the differences between carbohydrates contents was generally significant different (P<0.05), some flour samples had comparable values. Sample REP1 BED8 had the highest value of 80.80%, while flour sample TDR0500491 had the lowest value of 79.99 %. Table 1 shows the Fat content distribution in the new yam cultivars. The level of fat content distribution ranged from 0.34 % for sample TDR0900002 to 0.58 % for sample REP1 BED8. Significant difference (P<0.05) exist amongst the flour sample for fat content. Sample REP1 BED8 had the highest value of 0.58 %, while flour sample TDR0900002 had the lowest value of 0.34 %. Crude fibre as shown in Table 1 ranged between 1.45 % for sample TDR1100492 and 1.86 % for sample TDR0500491. Significant difference (P>0.05) does not exist amongst flour samples REP1 BED8, REP1 BED4 and TDR 0900002 for crude fibre, while significant difference (P<0.05) existed for the remaining flour samples. Total energy contents as shown in Table 1 reveals that all the flour samples had high energy value ranging from 368.60 k/cal for sample REP1BED4 to 386.60k/cal for sample TDR0900082. With this energy level, the flour samples could be used in the flour porridge for infants and children (Butte, 1996). Sample TDR0900082 had the highest value of 386.60%, while flour sample REP1BED4 had the lowest value of 368.60 %. Significant difference (P<0.05) exist for all the flour samples in the column for Total energy content in the new yam cultivars.

DISCUSSION

Proximate composition of selected new yam cultivars

The proximate compositions of selected new yam cultivars are as shown in Table 2 are discussed as follows;Moisture content of food depicts the amount of water available for the growth of micro-organism. It has been established that moisture content in excess of 14% in flours has greater danger of bacteria action and mould growth which produce undesirable changes [9]. Significant difference (P<0.05) exist amongst the flour samples in the column, except for flour samples TDR1100585 and TDR0900002 which are not significantly (P>0.05) different from each other. The samples moisture content which ranged from 10.08 % to 10.67 % is still within a tolerable level as reported by [10,11], the higher the moisture content, the higher the porosity. Moisture content reduced as drying proceeds, these results in more air space generation in a food material thereby increasing its porosity. Fibre provides bulk in diet. People who take large amounts of dietary fibre containing foods may have appetite satisfied before their energy requirements are met. Significant difference (P<0.05) were observed in the crude fibre contents of the flour samples except for flour samples REP1 BED8, REP1 BED4 and TDR0900082 which are not significantly different (P>0.05) from each other. The values of fibre content in this work was greater than those reported by [9] with value of 0.5%. Fibre has useful role in providing roughage that aids digestion [13]. Dietary fibre reduces the risk of cardiovascular diseases. Report have shown that the increase in fibre consumption might have contributed to the reduction in the incidence of certain diseases such as diabetes, coronary heart disease, colon cancer and various digestive disorder. Fibre consumption also soften stools and lowers plasma cholesterol level in the body [14]. The ash in foods signifies the presence of mineral contents. Table 1 shows that the ash content which is the total mineral content present in the flour samples ranged from 2.03 to 2.43 %, with flour sample REP1 BED8 having the lowest value of 2.03 % while flour sample TDR0900082 had the highest value of 2.43 %. Ash content is very important in many Biochemical reactions which aid physiological functioning of major metabolic processes in the human body [7]. Values were in agreement with those reported by [9], they recorded in whole tubers of yams (D.*alata*) 2.0% to 2.9 %. The result indicates an indication of the presence of inorganic nutrients in the flour samples, therefore the samples could be a source of mineral elements having nutritional importance. This was in accordance with the report of [9] which was on roots and tubers. Protein is an essential component of the diet for infant growth and adults, unlike fats and carbohydrates which is for energy. It is important that the adequate energy intake is provided along with adequate protein to enable amino acids do specific function of replacement of protein in the body growth. The protein content of the flour samples as shown in Table 2 ranged from 4.7 % to 6.97 %. Significant difference (P<0.05) exist amongst the flour samples for protein in the column, except for flour samples TDR1100585 and REP1 BED19 which are significantly different (P>0.05) from each other. Results obtained were in agreement with those reported by [6] with values of 4.34 to 6.96 % for root tuber (D.*rotundata*). Generally root tubers (yams, cassava and cocoyam) are poor sources of protein as reported by [20,24]. The decrease of protein content in the new yam cultivars flour could be explained by reduction of the protein synthesis capacity as well as proteolysis initiated by the proteases [23]. The increase in protein also enhances the hydrophobicity and exposed more the polar amino acid to the fat (Chua and Cheung, 2014). Thus, the decrease in protein content of the new yam cultivars would tend to reduce the hydrophobicity, and thereby causing a low fat binding to protein. Carbohydrates are classified as monosaccharide, disaccharides and polysaccharides which provide energy to the body, especially the brain which requires glucose to function. Its presence ensures that protein and fats are utilized efficiently in the body [9]. It is important to have an easily or readily digestible carbohydrate to avoid using protein as a source of energy. Inadequate energy obtained from carbohydrate would force the body to utilize protein as a source of energy. The carbohydrates contents in Table 2 ranged from 79.99 % to 82.20 %. Significant difference (P<0.05) exist amongst all the flour samples in the column for carbohydrates. Flour sample MECC9RU59 had the highest value of 82.20 %, while flour sample TDR 0500491 had the lowest value of 79.99 %; this observation of high carbohydrates content values is in line with the report of [15], which may be attributed to the high content of carbohydrates in yam. According to [18], off all the solid nutrients in roots and tubers, carbohydrate predominates. Carbohydrate supplies quick source of metabolizable energy and assist in fat metabolism. The apparent differences observed in the carbohydrate content may be attributed to the anaerobic breakdown of carbohydrates by the relevant microbes [7]. Fats are essential components of gratifying foods. They provide essential substrates for cell structure and wide variety of active component of the endocrine, coagulation and immune system. They are concentrated sources of energy and are also carriers for fat soluble vitamins (A, D, and E) [6]. Significant difference (P<0.05) exist amongst all the flour samples in the column for Fat content in Table 2. The values ranged from 0.34 to 0.58 % as shown in Table 1. Flour sample REP1 BED8 had the highest value of 0.58 %, while flour sample TDR0900002 had the lowest value of 0.34 %. The decrease in fat content could be associated with the oxidation of fat during the period of drying [9]. The low content of fat would enhance the storage life of the flour due to the lowered chance of rancid flavour development. Fat serves as energy store in the body. It can be broken down in the body to release glycerol and free fatty acids. The glycerol can be converted to glucose by the liver and used as a source of energy. Humans need energy from food for activity, growth, and normal development and it normally comes from foods containing carbohydrates, protein and fat. Energy or caloric requirement depends on many factors which includes; body composition, body size, body metabolic rate and the energy the body expends at rest. The total energy value in Table 1 ranged from 375.45 to 386.60 Kcal/100g. Significant difference (P<0.05) exist amongst flour sample TDR0900082, REP1 BED19 and TDR1100492, while significant difference (P>0.05) does not exist amongst flour samples TDR0900002, TDR 0500491, REP1 BED8 and flour sample TDR00396, MECC9 RU59, and TDR1100585.

CONCLUSION

In conclusion, the results from this research indicated that the new yam cultivars are rich in protein and ash contents.

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