IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 8, Issue 3 Ver. II (Mar. 2015), PP 31-33
www.iosrjournals.org

Effect of Fermentation on the Chemical Composition of Peeled Taro Cocoyam Meal (Colocasia Esculenta Var Esculenta)

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Abstract: *Peeled taro cocoyam (Colocasia esculenta var esculenta) chips were naturally fermented in water for 24 hours, 48 hours and 72 hours at room temperature ($30^0c\pm2^0c$). The quality of the fermented taro cocoyam samples was accessed by determining the microbiological quality, proximate composition as well as the anti-nutritional content. Mixed flora of bacteria (Lactobacillus spp and Leuconostoc mesenteriodes) and fungus (Sacchoromyes cerevisiae) were identified. The result revealed that the crude protein content of fermented taro cocoyam (FTC) increased markedly at the forty eight hour (48 hour) of fermentation and later declined at the seventy hour (72). Crude fiber decreased with increased hour of fermentation. The findings showed that nitrogen free starch (carbohydrate) decreased after 24 hour of fermentation whereas Ash (minerals) content increased after 24 hour. There was no difference in the other extract content across treatments. It was observed that ant-nutrients such as Tannins, Oxalates, Phytates and Saponin decreased with prolonged fermentation. An increase in PH was also recorded with prolonged fermentation.*

I. Introduction

Cocoyam is a perennial herbaceous plant of 0.5 to 2m tall, with an underground starchy corm which produces at its apex a whole of large leaves with long robust petioles. The leaves are heart-shaped, 2.0 to 50cm long, with rounded basal lobes. Cocoyam is grown in areas where there is rainfall of at least 2000cm per annum, so that best yields will be obtained as it requires high moisture for optional performance (Onwueme,1978). When rainfall is low, corm growth is reduced and the opposite is also true when rainfall is high-cocoyam grows in the tropics from sea level up to 2700cm (Bourke, 1982) with reduction of yield and increased time of maturity at higher altitudes due to lower temperature. Amongst the taros, the Eddoe types tolerates drier conditions than the Dasheen types and most of the Dasheen taros do best under flooded conditions. Cocoyam requires average daily temperature above 21^{0c} and so cannot grow well under frosty conditions. Cocoyam tolerates saline soils better than many other crops a $_{P}H$ of 5.5 to 6.5 is preferred (Bourke,1982).

Most cultivars, particularly the Dasheens, contain oxalic acid (0.1 to 0.4% fresh weight) mainly in the form of "raphides" i.e bundles of needle-shaped crystals of calcium oxalate embedded in the tissue (Kelsely,1985). Anti-nutrients like phytate, saponin, tannin and acid factors are also present. An unidentified irritant(s) may also be present in the tissues boiling, oven-drying as well as fermenting reduce irritancy (Eka, 1984).

There are a number of roles that micro-organism play in food processing either positive or negative. The positive aspects are generally regarded as part of the fermentation processing-namely; product preservation, flavor development and reduction of anti-nutrients (Ojokoh,2007). Furthermore, fermentation enhances the nutrients, vitamins, essential amino acids (proteins) by improving protein and fibre digestibility. The negative effects include spoilage of food products and contamination by pathogenic micro-organism (Ojokoh, 2007).
This paper seeks to evaluate the effect of fermentation on the nutritional value of taro cocoyam (Colocasia esculenta var. esculenta)

II. Materials And Method

Fresh taro cocoyam (Colocosia esculenta var. esculenta) corms were obtained from Bendeghe located in Etung local Government Area of cross River State of Nigeria. The cocoyam was peeled and chopped into tiny chips each weighing about 14gms. The chips were washed in sterile distilled water to remove microbial load. After washing, the chips were suspended in 100ml of sterile distilled water and the initial PH was determined. The samples were then incubated (fermented) at the temperature of $30^{oc} \pm 2^{OC}$ for 24hrs, 48hrs and 72hrs and the PH was read on daily basis.

Microbial Analysis

The technique employed isolating the micro-organisms present in the fermented taro cocoyam (FTC) was the pour-plate method of Mac Fadini (1980), while the taxonomic tools used included those of Barrit (1936), Buchanam and Gibbons(1974). The isolation was done on plate count agar (PCA) nutrient agar (NA) and potato dextrose agar (PDA).

Physico-chemical Analysis: Ph determination: ph of the FTC samples were determined using Hanna ph meter (model 800-276868)

Nutrient Analysis: The proximate composition (ash, ether extract, crude fibre and Nitrogen free extract) of the FTC was evaluated using the standard A.O.AC(2000) method. The protein was determined using the microkjeldahl method (Nx6.25). The anti-nutritional contents of both fermented (24hrs, 48hrs and 72 hrs) and unfermented crow cocoyam corms were estimated. Phytate was determined by the method of Wheeler and Ferrei (1971); tannin content was determined using Makker, et al. (1993) method; Saponin was determined using Thakur, et al. (1986) method and the oxalate content was determined usin Dye (1956) method.

Statiscal Analysis: Randomized complete block (RCD) design was used. Data were analysed using analysis of variance and the least significant difference method was used to separate mean that differed significantly (Steel and Torric,1980). Data were also analysed using mean± S.D.

III. Result And Discussion

A total of three (3) micro-organisms were identified on fermenting taro cocoyam (FTC) chips after 72hrs. The bacteria isolates were Lactobacillus spp and hetero-fermentative Leuconostoc Mesenteriodes (12x10 $^{-6}$ cfu/g). the fungus isolate was Saccharomyces cerevisiae (2x10 $^{-6}$ cfu/g) fermentative Leuconostoc Mesenteriodes helps break down carbohydrates , starch protein as well as lignicellulose thereby reducing fibre content of such food (Raimbaunt and Teive, 2001) Saccharomyces cerevisiae acts as a probiotics which would account for the increase in the protein content of the fermented samples. The changes in Ph in fermenting taro cocoyam (FTC) chips were shown in table one(1). There was an initial decrease in PH in the first 24hrs (PH 5.6+- 0.1 to 5.4+- 0.1). however, it was observed that, the solution became alkaline as a result of an increase PH throughout the fermentation. Raimbaunt and Tieve (2001) indicated that PH of a culture may change in response to metabolic activities. The initial decrease in PH was a result of the secretion of organic acid such as lactic acid. However, the increase in PH was generally due to the production of ammonia, which is characterized by the pungent smell of the fermented sample (odetakun,2000). The production of ammonia and amines is quite common during fermentation as a result of protein hydrolysis. The increase in ph was also due to protein-based fermentation (Adenike,et al; 2007) The results of the proximate analysis are shown in table.2 . fermentation generally increased the protein content of cocoyam corms, but it was observed that, 48hrs, FTC had the highest protein content. The increase in protein of FTC samples could be associated with the sample readily by secreting the extra-cellular enzymes which subsequently increased the protein content (during protein hydrolysis) as well as microbial biomass (Odetokun, 2000). There was no observable difference in the ether extract of the samples. Ash content was observed to have increased after 24hrs whereas, decrease in fibre content was observed at 24hrs of fermentation process enhances, nutrients, vitamins, minerals and improves fibre digestibility (Odetokun, 2000). A decrease in carbohydrates (NFE), after 24hrs observed. This was in line with Bough and Azam-Ali (1992) and Odetokun (2000) who reported that, decrease in carbohydrate during fermentation, carbohydrates including cellulose, pepsin, ligincelluloise and starch are broken down by fermentative micro-organisms thereby reducing the fibre of such food(Raimbaunt and Teive, 2001)

The levels of tannins, phytate, saponibn and oxalate which the plant probably uses for defense (Aletor, 1993) were also determined in the FTC samples (Table 3.it was observed that, prolonged fermentation reduced the level of tannin , phytate, saponin and oxalate to a more tolerable level. This could be attributed to the possible secretion of the hydrolytic enzymes by the micro-organisms identified in the FTC samples

Table 1: change in PH during fermentation of peeled taro cocoyam (Cococasia esculenta var. esculenta)

Fermentation time (hr)	PH
0	5.6 ± 0.10
24hrs	5.4 ± 0.00
48hrs	6.0 ± 0.10
72hrs	6.4 ± 0.00

Mean of 3 determinations ± S.D.

Table 2: proximate composition of fermented and raw taro cocoyam corms (cococasia esculenta var. esculenta).

Parameter %	Fermentation Time: Raw (control)	24hrs	48hrs	72hrs
CP	5.25^{d}	5.69^{c}	8.75^{a}	6.13^{b}
EE	0.50	0.50	0.50	0.50
NFE	89.75^{a}	89.31^{a}	86.75^{b}	85.87^{b}
ASH	2.00^{a}	2.00^{a}	2.50^{b}	2.50^{b}
CF	2.50^{a}	2.00^{b}	1.50^{c}	1.50^{c}

Different superscript within the same row (a, b, c and d) indicates significant ($p<0.05$) differences.

Table 3:effect of fermentation time on the anti-nutritional factors of peeled taro cocoyam corms (cococasia esculenta var. esculenta) (mg/100 dry weight).

Anti-nutrients	Raw (control)	24hrs fermentation	48hrs fermentation	72hrs fermentation
oxalate	35.75 ± 0.01	13.64 ± 0.01	8.58 ± 0.01	6.93 ± 0.1
Phytate	0.41 ± 0.01	0.38 ± 0.10	0.25 ± 0.01	0.12 ± 0.02
Saponin	5.50 ± 0.20	3.04 ± 0.01	2.05 ± 0.01	1.35 ± 0.02
Tannin	0.26 ± 0.01	0.12 ± 0.02	0.10 ± 0.01	0.07 ± 0.10

Mean of 3 determinations ± S.D.

IV. Conclusion

Fermentation had a positive effect on the nutritional composition of taro cocoyam (Colocosiai esculenta var esculenta) as it helps improves fibre digestibility, boost the protein content of cocoyam and reduces the anti-nutritional factors to a more tolerable level.

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