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Research Article

Effect of Fermentation on the Chemical Composition of Mango Kernel Meal (*Mangifera spp*)

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ABSTRACT

Mango kernels (*Mangifera spp*) were fermented in water for forty-eight hours (48 hour) at room temperature. The quality of the fermented mango kernel samples was accessed by determining the proximate composition as well as the anti-nutritional content. The result revealed that the crude protein content of fermented mango kernel meal increased markedly at forty-eight hours (48 hour) of fermentation. Crude fiber, ether extract, nitrogen free starch (carbohydrate) and Ash content decreased after 48 hours of fermentation. It was observed that anti-nutrients such as tannin, oxalates, saponin, alkaloid, phytate, trypsin inhibitor and cyanide decreased with forty-eight hours (48 hour) fermentation.

Key words: fermentation, chemical composition, mango kernel meal

INTRODUCTION

The mango is a very common tropical fruit usually found in Southern Asia, especially in Eastern India, China, Burma, Andaman Islands and Central America. Mangoes belong to the genus *Angifera*, consisting of numerous species of tropical fruiting trees in the flowering plant family *Anacardiaceae*. It is cultivated and grown vastly in many tropical regions and widely distributed in the world. The mango is indigenous to the Indian subcontinent and Southeast Asia (Fowomola, 2010). Cultivated in many tropical regions and distributed widely in the world. It is one of the most extensively exploited fruits for food, juice, flavor, fragrance and color and a common ingredient in new functional foods often called super fruits. Mango trees (*Mangifera indica*) reach 35 - 40 m in height, with a crown radius of 10 m. The leaves are evergreen, alternate, simple, 15 - 35 cm long and 6 - 16 cm broad; when the leaves are young they are orange-pink, rapidly changing to a dark glossy red, and then dark green as they mature. The fruit takes from 3 - 6 months to ripen. The ripe fruit is variable in size and color, and may be yellow, orange, red or green when ripe, depending on the cultivar.

Mango seed kernels (mango kernels) is the kernel inside the seed represents from 45% to 75% of the whole seed (Diarra, 2010). Mango seed kernels (MSK) contained carbohydrate (69.2 - 80%), protein (7.5 – 13%), fibre (2.0 – 4.6%), ash (2.2 – 2.6%), calcium (0.21%) and phosphorus (0.22%), which is comparable to that of maize, depending on the variety (Kiflewahid *et al*. 1982; Ravindran and Rajaguru 1985; Arogba 1989; Diarra *et al*. 2010). The kernel is also balanced in amino acids (Anon 1967). Despite its high content of nutrients, the use of Mango seed kernel in poultry feeding is limited by the presence of several anti-nutritional factors (ANFs). Processing methods such as; boiling, oven drying, autoclaving, fermentation etc could reduce these anti nutrients to a more tolerable state (Diarra *et al*., 2010).

There are number of roles that microorganism 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 microorganism (Ojokoh, 2007).

This paper seeks to evaluate the effect of fermentation on the nutritional value of mango kernel meal (*Mangifera spp*).

MATERIALS AND METHODS

Experiment site

This experiment was conducted at the Poultry Unit of the Teaching and Research Farm of the Federal University

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of Agriculture, Makurdi, Benue State. Makurdi is located at the longitude 6º 10' East and latitude 6º8' North. The area is warm with a minimum temperature range of 29.8-35.6ºC. Rainfall is between 508-1016mm and relative humidity is 47%-87% (Anon, 1995). One important geographical features of this area is the river Benue which divides Makurdi into the Northern and Southern parts. Makurdi local Government has an area of 16km radius. It lies within the Guinea savannah region of the Nigeria vegetative belt located in the Benue valley. Makurdi experiences a typical tropical climate with two distinct seasons (dry and wet). The dry season begins in November and ends in March while the wet season starts in April and ends in October. Harmathan with cool weather is experienced from December to early February (Anon, 1995).

Preparation of Experimental Materials

Different cultivars of both indigenous and improved mango were collected during the month of May (peak of the mango season) in Gboko and Makurdi area of Benue state, Nigeria. Mango kernel was removed by cracking manually with the aid of hammer. The fresh kernels were soaked in water at room temperature to allow it ferment for a period of 2 days (48hrs) in order to reduce the anti-nutrients to a more tolerable level and rinsed thoroughly with clean cool water. The fermented kernel was sundried in order to reduce the moisture content to less than 10% to prevent microbial build up and for prolonged storage.

Nutrient Analysis

The proximate composition (ash, ether extract, crude fibre, and nitrogen free extract) of the FMKM was evaluated using the standard A.O.A.C (2000) method. The protein was determined using the micro kjeldal method (Nx6.25). The anti-nutritional contents of both fermented and unfermented mango kernel composite meal were estimated. Phytate and trypsin was determined by the method of Wheeler and Ferrei (1971); tannin content was determined using Makker *et al*. (1993) method; alkaloid was determined using the method of Eka (1984); saponin was determined using Thakur *et al*. (1986) method and oxalate content was determined using Dye (1956) method.

RESULTS AND DISCUSSION

The proximate values obtained in this study show that fermentation had effect on the proximate composition of mango seed kernel. The values obtained for dry mango seed kernel in this study (Table 1) differ from the values (8.4 and 9.2% moisture, 10.06 and 7.6 crude protein, 2.4 and 2.8 crude fibre, 14.80 and 14.80 ether extract, 2.62 and 2.69 ash and 61.72 and 62.91 Nitrogen free extract reported by Fowomola (2010) and Diarra (2010). The differences may have resulted from the varieties of seeds used which affect the proximate attributes of mango seed kernel.

It was observed in this study that crude protein in the fermented mango kernel meal (11.03) was higher than in the sundried mango kernel (8.40). The observation that fermentation increase crude protein content agrees with the finding of (Odetokun, 2000) that fermentation tends to increase the protein content of feedstuffs. This is due to the fact that microorganisms involved in fermentation use the carbohydrate and fat in the substrate, with atmospheric nitrogen to synthesize their own body protein and evolve carbon dioxide and methane. These processes would result in the elevation of the overall protein content. The crude fibre content of sundried mango kernel was higher when compared with the fermented. This view is in agreement with the reports of Raimbaunt and Tewe (2001) that fermentative microorganism such as *Leuconostoc mesenteriodes* helps break down carbohydrate, starch protein, as well as lignin cellulose thereby reducing the fibre content. The NFE content of fermented mango kernel meal was slightly lower than that of sundried mango kernel meal. This result shows that a portion of soluble carbohydrates were converted during fermentation. This study agrees with the report of Damang (2013) in which the NFE content of fermented decorticated African locust bean seeds was observed to be lower than those in other processing method.

Table 1: Effect of Fermentation on the Proximate Composition of Mango Kernel Meal

Parameter (%)	Sun-dried	Fermented
Moisture	7.20	11.03
Crude protein	8.40	11.04
Ether extract	14.60	11.35
Crude fibre	2.90	2.40
Ash	2.62	2.10
Nitrogen free extract	64.27	62.06

Table 2: Effect of Fermentation on the Anti- nutritional Factors of Mango Kernel Meal

Anti- nutrients	Sun-dried	Fermented
Tannin (Mg/100g)	1.03	0.24
Saponin (Mg/100g)	0.04	0.02
Oxalates (Mg/ 100g)	1.49	0.64
Trypsin inhibitor (Tiu/g)	18.42	9.10
Phytate (Mg/100g)	1.44	0.28
Alkaloid (Mg/100g)	0.93	0.01
Cyanide (Ug/g)	0.25	0.04

Tannin content decreased from 1.03mg/100g for sundried mango kernel to 0.24mg/100g for fermented mango kernel. Tannin is known to give rise to a dry pickery astringent sensation in the mouth and can depress growth (Emire *et al*., 2013). Tannin has the capability of decreasing the digestibility and palatability of protein because they form insoluble complexes with them (Osagie *et al*., 1996).

Saponin level in sundried mango kernel was low (0.04mg/100g), even though sundried mango kernel meal had a higher amount when compared to fermented mango kernel meal 0.02mg/100g. Saponin are known to be bitter and reduce the palatability of livestock feed and increases the excretion of cholesterol (Price and Butler, 1980).

Trypsin value was low in sundried mango kernel (18.42 Tu/g) and in fermented mango kernel (9.60 Tu/g) when compared with other unconventional feedstuffs like *Canavalia ensiformis* (1681.50 Tu/g) and *Canavalia brazilensis* (166.20 Tu/g) as reported by Udedibie and Carlini (1998). Trypsin inhibitor is an enzyme which is known to interfere with the normal digestive actions of enzyme that breakdown protein to simpler components Udedibie and Carlini (1998).

Phytate and Oxalate according to Ojiaoko and Igwe (2008) form strong complexes with essential minerals like calcium, iron, magnesium and zinc which make them unavailable to the body. This may result in metabolic and mineral deficiency and disorders like hypocalcaemia, osteoporosis and paralysis in chicken. Abnormal levels of oxalates may also lead to kidney stone according to McDonald *et al*. (1995). The 0.28 and 0.64 concentration levels of phytate and oxalate respectively in fermented mango kernel observed in this study respectively are within tolerant values indicated by Kumar (1991) and Concon (1998). This implies that fermented mango kernel can supply the needed dietary phosphorus which combine with calcium to enhance strong bone formation and metabolic processes because phytic acid is the principal storage form of phosphorus in most plant tissues (Emire *et al*., 2013).

The reduction in the levels of anti-nutrient in fermented mango kernel is an indication that fermentation can help reduce the amounts of these substance in feedstuffs and therefore, a means of neutralizing or detoxifying anti-nutritional substances in feed ingredient.

Conclusion

Fermentation had a positive effect on the nutritional composition of mango kernel (*Mangifera spp*) as it helps improves the fibre digestibility, boost the protein content of mango kernel and reduces the anti-nutritional factors to a more tolerable level.

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