EFFECT OF LACTIC ACID BACTERIA STRAINS ON THE PROXIMATE COMPOSITION OF *JATROPHA CURCAS* L. KERNEL CAKE

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ABSTRACT
Three Lactic Acid Bacteria strains (Lactobacillus acidiophillus, Lactobacillus plantarium, and Lactobacillus rhamnosus) were used in the fermentation of Jatropha curcas kernel cake for a 7 days in a completely randomized design. The results revealed significant increase in the dry matter, crude protein content of all the bacteria treated samples however Lactobacillus rhamnosus treated cake recorded higher value compared with other treated samples. On the contrary, the untreated sample was significantly higher in crude fibre and ether extract. There was no significant difference in the ash content among all the samples. It could be concluded from this study that solid state fermentation using Lactic Acid Bacteria strains could improve the nutrient composition of Jatropha kernel cake.
Keywords: *Jatropha curcas* kernel cake, proximate composition, lactobacillus, fermentation, inoculate

INTRODUCTION

The global and Nigeria agricultural sector generate approximately 1300 and 32 million tonnes of waste annually respectively (Amran *et al* 2021; Lantz, 2021). The incorporation of these agricultural waste products in livestock feeds is a form of recycling of biological wastes, which will reduce pollution in developing countries (Lu *et al* 2022). A substantive quantity of unconventional feedstuffs derived from agricultural wastes abounds in Nigeria (Ologhobo, 1992). An example is the *J. curcas* seed cake, which is a waste by-product of biodiesel production industry. The detoxification and reuse of this seed cake is very important for adding economic value and also reduce potential environmental damage that may be caused by improper disposal of this by-product (Kasuya *et al* 2013).

Jatropha seed cake has high nutrient contents in terms of protein, energy and minerals (Boguhn *et al* 2010; Sumiati *et al* 2011). Unfortunately, incorporating them in animal diet remains a challenge because it has toxic chemicals that limit its utility, these include cyanide, saponin, tannin, phytate and phorbol ester. Many processing methods have been explored for the reduction of Anti-Nutritional Factors and detoxification of Jatropha Seed Cake with different degree of success (Belewu *et al.,* 2010) physical, mechanical, biological and chemical are well documented and also combination the methods (de Barros *et al.,* 2011; Sadubthummarak *et al* 2013).

The biological strategy of Solid-State Fermentation (SSF) seems to be the most promising and inexpensive way to improve nutritional value, alleviate the effect of anti-nutrient compounds, regulate loss of protein and decrease environmental degradation compared to other strategies (Shi *et al* 2015; Çabuk *et al* 2018). Lactobacillus has been used in alleviating anti-nutrients present in the feedstuffs (Sharma, *et al* 2022). Fermentation with lactic acid bacteria improves nutritional value and enhances shelf life (Ruan *et al* 2019; Tan *et al* 2020). This study was an attempt to determine whether lactic acid bacteria fermentation could improve the nutritional contents of *Jatropha curcas* kernel cake.

MATERIALS AND METHODS

Experimental Location

The experiment was carried out at Department of Animal Production Laboratory, University of Ilorin, Ilorin, Kwara State, Nigeria.

Preparation of the Substrate

The substrate (milled dehulled *J. curcas* kernel cake) was obtained from University of Ilorin Jatropha plantation unit and was soaked in solvent (Petroleum ether) for 24 hours. Thereafter, it was pressed with a sieving cloth and air dried for three days to get rid of the oil. The defatted cake was autoclaved at 121°C for 15 minutes.

Bacteria Source

Lactobacillus acidiophillus, *Lactobacillus plantarium* and *Lactobacillus rhamnosus* were obtained from the National Microbiological Centre, Abuja and maintained on nutrient agar containing in petri dishes for growth of the organisms.

Preparation of Inoculum and Incubation of the Jatropha kernel Cake

Pure strains of Lactobacillus spp (*L. acidiophillus*, *L. plantarium* and *L. rhamnosus*) were reactivated by subculturing anaerobically in De Man, Rogosa, and Sharpe agar (MRS) broth at 37°C for 24h. The defatted *J. curcas* kernel cake was inoculated with the spores of the bacteria (Lactobacillus spp). The inoculated substrate was covered with black polythene bags and incubated at room temperature to allow the organism to grow on the substrate for first four days turned and allowed to continue its growth for another three days. After which the growth was terminated by oven dried and kept in an airtight container prior to analysis.

Chemical Analysis

The prepared *J. curcas* kernel cake was analyzed in the laboratory for proximate analysis following the method of AOAC (2000) while the Neutral detergent fibre (NDF), Acid detergent fibre (ADF) and Acid detergent lignin (ADL) were determined using the method described by Van Soest *et al* (1991). Hemicellulose was calculated as the difference between NDF and ADF while cellulose is the difference between ADF and ADL.

Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) using (SAS®) software (2002). The Duncan multiple range tests were used to compare means (Duncan, 1955).

RESULTS AND DISCUSSION

Proximate Composition of Treated and Untreated *Jatropha curcas* Kernel Cake

The proximate composition of *Lactobacillus* spp treated and untreated *Jatropha curcas* kernel cake (JKC) is presented in Table 1. The Crude protein (CP) value of 38.23% was observed for untreated *Jatropha curcas* kernel cake in this study, which was lower than the value reported by (Belewu *et al.,* 2010) who reported 50.80% for untreated *Jatropha curcas* and higher than (28.40%) reported by (Ganiyu and Belewu, 2023). Also, a significantly higher crude protein and dry matter content were recorded in bacteria treated Jatropha seed kernel cakes when compared to untreated sample. The increased in dry matter and crude protein contents as a result of treating *Jatropha curcas* kernel cake with *lactobacillus spp* agreed with the report of Belewu *et al*., (2010) (87.83% to 93.00%) and (Ameen *et al*., 2011 and Sanusi *et al.,* 2013) who also reported increased crude protein for some fungi and (Zhang *et al.,* 2016) who reported increased crude protein for some bacteria treated jatropha seed cakes, but disagreed with (Ganiyu and Belewu, 2023) who reported a decrease from 28.40% to 24.54% for untreated and treated respectively. These increases were due to the activities of the microbes during the fermentation process (Martinez-Herrera *et al.,* 2010; Belewu *et al.,* 2010).

In this study lower values were observed for ether extract and crude fibre in *lactobacillus spp* treated Jatropha seed kernel cakes compared to the untreated Jatropha seed kernel cakes, this is in line with earlier studies of Ameen *et al*., (2011) who reported a decrease in the ether extract content of *Mucor mucedo* and *Aspergillus niger* treated Jatropha seed kernel cakes from 9.02% to 4.70% for untreated and treated respectively, and Sanusi *et al*. (2013) who reported a decrease in the ether extract contents of *Rhizopus Sp., Absidia spinosa. . Aspergillus Sp., Mucor rouxii* and *Klebsilla oxytoca* treated samples from 6.50% to 2.55%. The observed lower crude fiber could be attributed to the activities of a number degrading enzymes (cellulase, xynalase, pectinase, chitin, amylase, hemicellulase, lipase etc) secreted by the micro-organisms during the fermentation process (Belewu *et al*., 2010). The observation also confirmed the assertion of Jacqueline and Visser (1996) and Belewu and Popoola (2007).

There was significant decrease in the (neutral detergent fibre) and acid detergent fibre among the bacteria treated and untreated Jatropha seed kernel cakes. The observed decrease in the values of hemicellulose, cellulose and lignin (neutral detergent fibre) and acid detergent fibre (lignin and cellulose) for the bacterial treated Jatropha kernel cake and it could be an indication of active degradation of the cell wall components of the substrates produced by extra cellular enzymes. (Sanusi *et al*. 2013).

Table 1: Proximate composition of the treated and untreated *Jatropha curcas* kernel cake on dry matter basis

PARAMETERS (%)	UJKC	LA	LP	LR	±SEM	P-Value
Dry Matter	87.83[d]	89.17[c]	93.00[a]	90.67[b]	0.125	< 0.0001
Crude Protein	38.23[d]	44.29[b]	47.38[b]	52.23[a]	0.878	< 0.0001
Crude Fibre	13.87[a]	10.67[b]	7.478[c]	8.27[c]	0.241	< 0.0001
Ether Extract	19.73[a]	17.48[b]	17.73[b]	14.56[c]	0.253	< 0.4001
Ash	7.92	8.23	8.15	7.99	0.203	< 0.0001
Nitrogen free extracts	8.09[b]	8.22[b]	11.92[a]	7.63[b]	1.540	< 0.0106
Neutral detergent fibre	52.33[b]	64.67[a]	37.3[c]	30.00[c]	40.750	< 0.0010
Acid detergent fibre	6.80[a]	7.67[a]	5.60[b]	5.03[b]	0.264	< 0.0007
Hemicellulose	45.53[a]	57.00[a]	31.73[b]	24.97[b]	12.070	< 0.0010
Lignin	0.27[a]	0.18[b]	0.14[bc]	0.11[c]	0.007	< 0.0005
Cellulose	3.90[a]	2.67[b]	2.23[b]	1.67[c]	0.180	< 0.0004
Silica	2.63[b]	4.82[a]	3.22[b]	3.75[ab]	0.446	< 0.0208

UJKC- Untreated *Jatropha curcas* kernel cake; LA-*Lactobacillus acidiophillus*; LP-*Lactobacillus plantarium* ; LR-*Lactobacillus rhamnosus*;

CONCLUSION AND RECOMMENDATION

Based on this study it can be concluded that fermentation of *Jatropha curcas* kernel cake with *lactobacillus spp* helps in improving the nutritional content of the seed kernel cakes. This is an indication that *lactobacillus spp* treated Jatropha kernel cake is nutritionally promising as a good source of protein, digestible crude fibre and minerals.

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