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Impact of Lactobacillus Fermented Cassava Peel on Adiposity and Metabolic Parameters in Rats

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Abstract

The increasing prevalence of obesity and related metabolic disorders necessitates exploration of novel, cost-effective interventions. Cassava peel, a waste product, is rich in nutrients but underutilized. While *Lactobacillus* fermentation enhances nutritional value, its impact on body mass indices remains unclear. Existing studies focus on nutritional enhancement, leaving a gap in understanding its effects on obesity management, creating a need to investigate the potential of *Lactobacillus* fermented cassava peel in modulating body mass indices in rats. This study investigated the effects of fermented and non-fermented cassava peel on body mass indices (BMI) of rats. The fermenter was isolated and characterized using standard microbiological techniques. Thirty rats were divided into control, fermented, and non-fermented groups. BMI was calculated weekly for six weeks. The fermenter used in the study was identified to be *Lactobacillus acidophilus* strain DSN20079 (LADSM). The results of the study showed significant increases in BMI in the non-fermented group (0.57 to 0.67 g/cm², $p < 0.001$) and fermented group (0.57 to 0.64 g/cm², $p = 0.021$) compared to the control group (0.57 to 0.62 g/cm²). The non-fermented group's BMI approached overweight/obese status (BMI ≥ 0.68 g/cm²). These findings suggest non-fermented cassava peel may promote more significant weight gain and BMI increase compared to fermented cassava peel. The study highlights the importance of processing methods on cassava peel's nutritional effects and recommend fermented cassava peel as growth enhancer and weight management in livestock.

Keywords: Fermenter, *Lactobacillus*, Cassava peel, Body-mass-index, Rats.

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Introduction

Cassava (*Manihot esculenta*) is a staple food crop in many tropical regions, with its peel often discarded as waste despite its nutritional potential (Awojobi *et al.*, 2016; Iheukwumere *et al*., 2025a; Dim *et al*., 2025a). The peel is rich in fiber, carbohydrates, and minerals, making it a valuable resource for animal feed and potentially for human consumption (Okunola *et al.*, 2019). However, cassava peel contains cyanogenic glycosides, which can be toxic if not properly processed (Burns *et al.*, 2012). Fermentation has been shown to reduce cyanide content and enhance the nutritional value of cassava products (Oboh *et al.*, 2012; Iheukwumere *et al*., 2022a; and Nwike *et al*., 2017).

Fermentation of cassava peel using microorganisms like *Lactobacillus* can increase its protein content, reduce anti-nutritional factors, and improve digestibility (Adeyemo *et al.*, 2018; Ekechukwu *et al.*, 2025a; Obianom *et al*., 2024; Dim *et al*., 2025b). *Lactobacillus* species are known for their probiotic properties, contributing to gut health and modulating metabolic processes (Million *et al*., 2012). The use of fermented cassava peel as a dietary supplement has been explored in animal studies, showing potential benefits in growth performance and gut health (Awojobi *et al.*, 2016). However, its impact on adiposity and metabolic parameters remains underexplored.

Adiposity and metabolic disorders are growing health concerns globally, with obesity increasing the risk of diabetes,

cardiovascular diseases, and certain cancers (WHO, 2020). Dietary interventions using functional foods and probiotics have gained attention for their potential in managing weight and metabolic health (Kadooka *et al.*, 2010; Iheukwumere *et al*., 2025b, Dim *et al*. 2025c). Fermented foods, rich in probiotics and bioactive compounds, may modulate gut microbiota, influence energy metabolism, and impact adiposity (Cani *et al.*, 2012). Studies have shown that Lactobacillus species can reduce body weight and improve glucose metabolism in animal models (Million *et al.*, 2012).
The gut microbiota plays a crucial role in energy harvest from diet, fat storage, and metabolic regulation (Bäckhed *et al.*, 2004). Alterations in gut microbiota composition, known as dysbiosis, are associated with obesity and metabolic disorders (Ley *et al*., 2005). Probiotics and fermented foods can restore gut balance and improve metabolic outcomes (Cani *et al*., 2012). However, the specific effects of *Lactobacillus* fermented cassava peel on adiposity and metabolic health are not well understood, highlighting the need for research in this area.

Cassava peel utilization as a feed ingredient has been studied, but its metabolic impact, especially when fermented, is less explored (Okunola *et al*., 2019). Fermentation enhances nutrient bioavailability and may produce bioactive peptides influencing metabolic pathways (Adeyemo *et al.*, 2018). The potential anti-obesity effects of fermented foods are attributed to modulation of gut microbiota, improved gut barrier function, and regulation of appetite and lipid metabolism (Cani *et al.*, 2012). Some *Lactobacillus* strains have shown strain-specific effects on weight management and glucose homeostasis (Million *et al*., 2012; Amadi *et al*., 2017; Ejike *et al*., 2017).

The increasing prevalence of obesity and related metabolic disorders necessitates exploration of cost-effective, sustainable interventions. Utilizing cassava peel, an agricultural waste, through fermentation could provide a value-added product with health benefits. However, studies on the metabolic effects of Lactobacillus fermented cassava peel are scarce, and findings from other fermented foods may not be directly applicable due to differences in composition and microbial profiles.

This study aimed to evaluate the impact of *Lactobacillus* fermented cassava peel on adiposity and metabolic parameters in rats. Despite the potential of fermented foods in metabolic health, there is a research gap in understanding the specific effects of *Lactobacillus* fermented cassava peel on obesity and related metabolic outcomes. This study addresses this gap by investigating the effects on body mass index.The findings will contribute to understanding the potential of fermented cassava peel as a functional food ingredient for metabolic health management.

Materials and Methods

Isolation of the Test Sample

The media used for this isolation was de Man Rogosa and Sharpe broth (MRS) (BIOTECH). A 1.0 ml of fermented yoghurt (Aqua yoghurt) and banana extract were aseptically introduced into sterile Petri dishes (90 mm x 15 mm), then 20 ml of MRS which was prepared according to the manufacturers instruction and the procedures described in Cheesbrough (2010), Ekechukwu *et al*. (2025b), Ekesiobi *et al*., (2025), Ezedianafo *et al*., (2025a) was added into the plates, allowed to solidified. The plates were incubated in a microaerophic environment (containing candle used to evacuate all traces of oxygen thereby creating an environment having only carbon IV oxide). The incubation was done for 24 – 48 h at (30 ± 2^0C).

Purification of the Isolates

The plate that showed discrete colonies were selected after 24 - 48 h and each colony was aseptically streaked using a sterile wire loop on a sterile poured plate (90mm x 15mm) containing nutrient agar (BIOTECH) prepared according to the manufacturers description. after which it was incubated at their required growth conditions as described by Iheukwumere *et al*. (2020a), Ezedianafo *et al*. (2025b); Idigo *et al*. (2025a), Iheukwumere *et al*. (2025c).

Characterization of the Bacteria Pure Isolates

The pure isolates were characterized using the morphological, biochemical and molecular characteristics as described by Iheukwumere *et al.* (2017a); Iheukwumere *et al.* (2018a), Ike *et al*. (2025a), Iheukwumere *et al*. (2025d).

Morphological characteristics of the Bacteria isolates

The cultural descriptions (size, appearance, edge, elevation, colour) of the isolates were carried out as described in Goldman and Green (2009); Iheukwumere *et al*. (2017b), Iheukwumere *et al*. (2018b), Iheukwumere *et al*. (2020b). The Gram staining technique which revealed the Gram reaction, cell morphology and cell arrangement were also carried out using the procedure described by Cheesbrough (2010), Goldman and Green (2009) Frank and Robert (2015), Iheukwumere *et al*. (2022b), Iheukwumere *et al*. (2023a). The presence or absence of capsule was also carried out as described by Goldman and Green (2009), Ike *et al*. (2025b), Obiefuna *et al*. (2025a). The presence or absence of flagellum was determined by carrying out motility test as described by Cheesbrough (2010), Iheukwumere *et al*., (2017c), Iheukwumere *et al*. (2018c), Iheukwumere and Iheukwumere (2022a).

Gram staining technique

A thin smear was made in a cleaned grease free microscopic slide (75mm×25mm), air dried heat fixed. The smear was flooded with crystal violet solution (0.2%) for 60 seconds and rinsed with cleaned water. Gram iodine solution (0.01%) was then applied and allowed for 60 seconds. This was rinsed with cleaned water. This was followed by decolourizing the slide content with 95%w/v ethyl alcohol for 10seconds and then rinsed with cleaned water. The smear was then counter stained with safranin solution (0.025%) for 60 seconds, rinsed with cleaned water, blot drained and air dried. The stained smear was covered with a drop of immersion oil and observed under a binocular compound light microscope using × 100 objective lens as described by Iheukwumere *et al.* (2017d); Iheukwumere *et al*. (2020c), Chude *et al*. (2020), Iheukwumere and Iheukwumere (2022b), Iheukwumere *et al*. (2022c).

Motility test: A semi-solid medium prepared by mixing 5.0g of bacteriological agar (BIOTECH) with 2.0g of nutrient broth (BIOTECH) in 1 Litre of distilled water was used. The solution was dissolved and sterilized using autoclaving technique after dispensing 10 ml portion in different test tubes. The test tubes were allowed to set in vertical positions and then inoculate the test organisms by performing a single stab down the centre of the test tube to half the depth of the medium using sterile stabbing needle. The test tubes were kept in an incubator in vertical position at 35 ± 2^0C for 24h (Iheukwumere *et al*., 2017e; Iheukwumere and Iheukwumere, 2022c; Iheukwumere *et al*., 2022d; Idigo *et al*., 2025b).

Biochemical characteristics of the isolates

Indole test: Indole is a nitrogen containing compound formed when the amino acid tryptophan is hydrolyzed by bacteria that have the enzyme tryptophanase. This is detected by using KOVAC's reagent. For this test, isolates were cultured in peptone water in 500.0 ml of deionized water. Ten millilitres of peptone water was dispensed into the test tubes and sterilized. The medium was then inoculated with the isolates and kept in an incubator at 37˚C for 48 hr. Five drops of KOVAC's reagent were carefully layered onto the top of 24 h old pure cultures. The presence of indole was revealed by the development of red layer colouration on the top of the broth cultures as described by Iheukwumere *et al*. (2022e), Iheukwumere and Iheukwumere (2022d), Iheukwumere *et al*. (2023b), Egbe *et al*. (2025a), Ike *et al*. (2025c).

Sugar fermentation test: The capability of the isolates to metabolize some sugars (glucose, xylose, ducitol, maltose, arabinose, inositol, mucate and lactose) with the resulting formation of acid and gas or either were carried out using sugar fermentation test. One litre of 1% (w /v) peptone water was added to 3 mL of 0.2% (w/v) bromocresol purple and 9 ml was dispensed in the test tube that contained inverted Durham tubes. The medium was then sterilized by autoclaving. The sugar solution were prepared at 10% (w/v) and sterilized. One milliliter of the sugar was dispensed aseptically into the test tubes. The medium was then inoculated with the appropriate isolates and the cultures incubated at 37˚C for 48 h and were examined for the formation of acid and gas. Change in colour from purple to yellow indicated acid formation while gas formation was assessed by the presence of bubbles in the inverted (Iheukwumere *et al*., 2022f; Iheukwumere and Iheukwumere, 2022e; Egbe *et al.*, 2025b; Idigo *et al*., 2025c)

Methyl red test: The glucose phosphate broth was prepared according to the manufacturer's direction and the isolates were aseptically inoculated into the sterilized medium. This was incubated at 37˚C for 48 hr. After incubation, five drops of 0.4 % solution of alcoholic methyl red solution was added and mixed thoroughly, and the result was read immediately. Positive tests gave bright red colour while negative tests gave yellow colour (Ezedianafo *et al*., 2025c; Ike *et al*., 2025c).

Voges-Proskauer test: The glucose phosphate broth was prepared in accordance to the manufacturer's direction and the isolates were aseptically inoculated into the sterilized medium. This was incubated at 37˚C for 48hr. After incubation, 1.0 mL of 40% potassium hydroxide (KOH) containing 0.3% Creatine and 3 ml of 5% solution of α-naphthol was add ed in the absolute alcohol. Positive reaction was observed by the development of pink colour within five minutes (Egbe *et al*., 2025b; Ekechukwu *et al*., 2025c).

Citrate utilization test: The Simmon's Citrate Agar was prepare according to the manufacturer's direction and the isolates were inoculated by stabbing directly at the center of the medium in the test tubes and incubated at 37˚C for 48 hr. Positive test was shown by the appearance of growth with blue colour, while negative test showed no growth and the original green colour was retained (Idigo *et al*., 2025d; Ezedianafo *et al*. 2025d).

Catalase test: The test was carried out as described by Cheesbrough (2010). A smear of the isolate was made on a cleaned grease-free microscopic slide. Then, a drop of 30% hydrogen peroxide (H_2O_2) was added on the smear. Prompt effervescence indicated catalase production (Idigo *et al*., 2025e; Idigo *et al*., 2025f).

Oxidase test: The test involved two drops of freshly prepared oxidase reagent dispensed on Whatman No. 1 filter paper which was placed in Petri dish, and a smear of the test isolate was made on the spot using a sterile stick. The development of blue-black colouration was checked within 15 seconds.

Urease test: This was carried out as described by Cheesbrough (2010), Idigo *et al*. (2025g) and Idigo *et al*. (2025h). The urea agar slant was prepared in accordance to the manufacturer's direction and the isolates were aseptically inoculated into sterilized medium. This was incubated at 37^0C for 48 h. After incubation, observation was made for the presence of purple-pink colouration.

Molecular characterization of the isolates

Extraction and purification of DNA: All strains were plated on Nutrient Agar (Biotech) and incubated at 37°C for 24 hr. By means of the procedures of Zymo Research (ZR) DNA miniprepTM kit, bacterial genomic DNA was then extracted and purified (Category No. D6005; Irvine, California, USA) as described by Iheukwumere *et al.* (2018) Iheukwumere *et al*. (2025e; Idigo *et al*., 2025h).

Determination of the quality of extracted DNA: Using mass spectrophotometer (Nanodrop), One micro litre (1µL) was aseptically dropped into a fresh space in the chamber and the chamber was lightly closed which was then linked to a computer system which showed the window that discovered the value of the sample at 260/280nm as described by (Iheukwumere *et al.*, 2018; Iheukwumere *et al*., 2025f; Idigo *et al*., 2025i).

Amplification of DNA and gel electrophoresis of PCR product: This was analysed using Master cycler Nexus Gradient (Eppendorf). A mixture of primer (20 µL), template DNA (20µL), water (72 µL) and master mix (108 µL), which comprises taq polymerase, dimethylsulfoxide (DMSO), magnesium chloride ($MgCl_2$) and nucleotides triphosphates (NdTPs), was made in 1.5 mL tube and homogenized using vortex mixer (Eppendorf). This was then positioned in the block chamber of the master cycler and then programmed. The PCR program for conditions were as follows: initial incubation at 94°C for 5 mins, followed by 35 cycles of denaturation at

94°C for 15 secs, annealing at 55°C for 15 secs, elongation at 72°C for 21 secs and final extension period for 10 mins at 72°C. The amplified products were electrophorezed in 1.0% agarose gel and a1kb DNA ladder was used as a size reference. After staining with 3µL of nucleic acid stain (GR green), the gel was documented with gel documentation apparatus (Iheukwumere *et al.*, 2018; Iheukwumere *et al*., 2025g; Idigo *et al*., 2025j; Idigo *et al*., 2025k).

DNA sequencing of 16s rRNA fragment: The 16S rRNA amplified PCR products generated from universal primer (16S), was used for the sequencing using ABI DNA sequencer (Applied Biosystem Inc) at International Institute of Tropical Agriculture (IITA), Ibadan using the method of Iheukwumere *et al.* (2018), Iheukwumere *et al*., (2025h), and Idigo *et al*. (2025l), Idigo *et al*., (2025m).

Computational Analysis: This was analysed making use of the modified method of Iheukwumere *et al.* (2018), Iheukwumere *et al*. (2025i), Idigo *et al*. (2025n), Iheukwumere *et al*., (2025j). The chromatograms generated from the sequences were cleaned to obtain regions with normal sequences. The cleaned nucleotides were aligned using pair wise alignment tool. The consensus sequences formed by the alignment of the forward and reverse sequences were used to perform the Basic Local *Alignment* Search Tool (BLAST) using National Centre for Biotechnology Information BLAST over the internet. The sequences of the isolates with 95% and above similarities were accepted. Also the maximum scores, total scores and accession numbers of the isolates were assessed. The relatedness of the isolates was determined by tracing their phylogenetic tree using DNA distance neighbour phylogenetic tree tool.

Preparation of Feed Supplement

Preparation of the cassava peel

The cassava peel was properly collected from the appropriate sites, washed and air dried. The material was ground using an electrical blender, packed in 500 ml beaker (PYREX) sealed with aluminium foil and then autoclave at 121^0C for 15 PSI in 15 min.

Fermentation Process

This was carried out using the modified method of Iheukwumere *et al* (2022), Iheukwumere *et al*. (2025k), Iheukwumere *et al*. (2025l). After autoclaving, a 100 g of the sterile sample was weighed into another 250 ml beaker (PYREX) using analytical weighing balance, which was properly sterilized using electric oven at 180^0C for 2 h, This was then inoculated with the fermenter (10 ml) prepared and diluted to a turbidity that matched 0.5 MacFarland standard that was prepared by mixing 0.6mL of 1% $BaCl_2$. $2H_2O$ and 99.4 mL of 1% Conc. H_2SO_4. This was allowed for 7 days.

Storage and packaging

After fermentation, the fermented samples were aseptically dried using an electric oven at 80^0C for 7days**.** After drying water activity of the fermented samples was determined, after which it was pulverized into powder and stored in a sterile container.

Moisture Content Determination

A crucible was dried, cooled, and weighed (initial weight recorded as W1). Then, 2.0 grams of the sample was added to the crucible, and its weight was recorded as W2. The crucible with the sample was heated in an oven at 105°C for 4 to 6 hours. After heating, the final weight of the crucible and its contents was measured (final weight recorded as W3). The percentage moisture content was subsequently calculated using the formula:

$$\%\ \text{moisture content} = \frac{W_2 - W_3}{W_2 - W_1} \times \frac{100}{1}$$

Experimented rats: A total of thirty (30) Albino Wistar rats were purchased from animal farm at University of Nigeria, Nsukka were used for the study. The rats were kept in separate, thoroughly cleaned and disinfected house and provided with feeds and water ad libitum.

Feed Additive

The fermented cassava peel was mixed with the feed in a ratio of 1:20. This mixture was properly and thoroughly mixed and administered to the chicks. Thirty (10 rats per group) rats were divided into control, fermented, and non-fermented groups The experimental animals were fed in the morning, afternoon and night together with water for 6 weeks.

Body weights: The body weights of the experimented rats were checked and recorded weekly using electronic weighing balance (LXD200) and recorded as described in the work published by Nwobodo *et al*. (2018), Iheukwumere *et al*. (2025m).

Body Mass Index: The Body Mass Index (BMI) was calculated by dividing the weight by square of the height, and this was expressed in g/m^2 (Iheukwumere *et al*., 2025n).

Statistical Analysis: The data obtained in this study were presented in tables and figures. Their percentages were also calculated. The sample means and standard deviations of some of the analytical data were also calculated. The significance of this study was determined at 95% using one way analysis of variance (ANOVA). Post-hoc analysis was conducted using Boniferroni correction test, Trend analysis was conducted using Cochran -Armitage test for dose response. Pair wise comparison was done using Fisher's Exact test as described in the study published by Iheukwumere *et al*. (2018), Idigo *et al*., (2025o), Idigo *et al*. (2025p), Idigo *et al*. (2025q), Idigo *et al*. (2025r), Idigo *et al*. (2025s), Idigo *et al*. (2025t), Manasseh *et al*. (2025).

Results

The cultural and morphological characteristics of the fermenter (Isolate P) were determined. The isolate appeared as cream-white colonies on MRS agar with low-convex elevation and smooth edges. Microscopically, the cells were Gram-positive rods, non-spore forming, and non-motile. These characteristics are typical of *Lactobacillus* species. The biochemical characteristics of Isolate P were assessed. The isolate was catalase-negative, citrate-negative, oxidase-negative, and urease-negative, consistent with Lactobacillus species. It fermented glucose, lactose, maltose, fructose, and

some other sugars, suggesting a profile typical of *Lactobacillus acidophilus*. Based on these tests, the isolate was identified as a *Lactobacillus* species. Nucleic acids were extracted from Isolate P with a concentration of 142.40 µg/mL and a 260/280 ratio of 1.83, indicating relatively pure DNA. Molecular identification via sequencing showed 100% identity to *Lactobacillus acidophilus* strain DSM20079, confirming the isolate as *L. acidophilus* ($p < 0.001$, E-value = 0.0).

The BMI of rats in the control, fermented, and non-fermented groups was monitored over six weeks. By week 6, the non-fermented group had the highest BMI (0.67 g/cm²), approaching overweight/obese status (BMI ≥ 0.68 g/cm²). The fermented group had a BMI of 0.64 g/cm², while the control group had 0.62 g/cm². Differences between groups were statistically significant ($p < 0.05$). Statistically significant differences in BMI were observed between groups ($p < 0.05$). The non-fermented group showed a trend towards higher BMI compared to the fermented and control groups. The results suggest that non-fermented cassava peel may promote more significant weight gain and BMI increase compared to fermented cassava peel. The study highlights the importance of processing methods on cassava peel's effects on metabolic parameters.

Table 1: Cultural and morphological characteristics of the fermenter

Parameter	Isolate P
Appearance	Cream-white on MRS agar
Elevation	Low-convex
Edge	Smooth
Surface	Smooth
Optical Nature	Transparent
Gram Reaction	+
Cell Morphology	Rods
Spore	_
Position of Spore	_
Motility	_

+ + Positive; - = Negative

Table 2: Biochemical characteristics of the fermenter

Parameter	Isolate P
Catalase	_
Citrate	_
Oxidase	_
Urease	_
Gelatin	_
Methyl Red	_
Voges Proskauer	_
Glucose	+
D-mannitol	+/_
Lactose	+
Maltose	+
Xylose	_
Inositol	+/_
Fructose	+
Sorbitol	_
Trehalose	+/_
Dulcitol	+/_
Possible Isolate	*Lactobacillus* species

Table 3: Authentication of nucleic acids extracted from the fermenter

Sample ID	Nucleic Acid Conc(µg/mL)	260 nm	280 nm	260/280
P	142.40	3.1915	1.7440	1.83

Table 4: Molecular identities of the fermenter

Parameter	Isolate P
Max Score	6593
Total Score	10535
Query Cover (%)	100
E-Value	0.0
Identity (%)	100
Accession Length	2009973
Accession Number	CP020620.1
Description	*Lactobacillus acidophilus* strain DSM20079 Chromosome Complete genome (LADSM)

Table 5: Body mass indices (BMI) of the rats

Week	Control Group			Fermented Group			Non-fermented Group		
	Length (cm^2)	Body weight (g)	BMI (g/cm^2)	Length (cm^2)	Body weight (g)	BMI (g/cm^2)	Length (cm^2)	Body weight (g)	BMI (g/cm^2)
1	14.66± 0.11	122.96±0.33	0.57	14.66± 0.12	122.94±0.34	0.57	14.68± 0.07	123.11± 0.77	0.57
2	15.02± 0.13	133.10±0.57	0.59	15.22± 0.03	146.56±0.77	0.63	16.12± 0.77	165.98± 0.51	0.64
3	16.12± 0.17	158.51±0.81	0.61	16.01± 0.07	168.86±0.47	0.64	18.01± 0.12	217.32± 0.83	0.67
4	17.01± 0.07	176.50±0.39	0.61	17.41± 0.07	199.81±0.33	0.64	19.98± 0.47	267.46± 0.67	0.67
5	18.82± 0.14	219.60±0.67	0.62	19.02± 0.11	237.76±0.62	0.64	20.86± 0.21	291.54± 0.83	0.67
6	20.62± 0.11	263.61±0.77	0.62	21.22± 0.14	298.66±0.74	0.64	22.03± 0.07	325.17± 0.67	0.67

BMI of 0.68 g/cm^2 or greater is generally considered overweight or obese

Discussion

The cultural, morphological, and biochemical characteristics of Isolate P were consistent with *Lactobacillus* species, as reported by other researchers (Adeyemo *et al.*, 2018; Oboh et al., 2012). The isolate's Gram-positive rods, non-spore forming, and non-motile nature aligned with typical Lactobacillus profiles (Million *et al*., 2012). Biochemical tests indicated fermentation patterns typical of *Lactobacillus acidophilus*, corroborating findings by Kadooka *et al.* (2010). Molecular identification confirmed Isolate P as *Lactobacillus acidophilus*, showing 100% identity to L. acidophilus strain DSM20079. This aligns with studies using 16S rRNA sequencing for *Lactobacillus* identification (Awojobi *et al.*, 2016; Okunola *et al.*, 2019). The high purity DNA (260/280 ratio = 1.83) ensured reliable sequencing results.

The non-fermented cassava peel group showed a trend towards higher BMI compared to fermented and control groups . This suggests non-fermented cassava peel may promote more significant weight gain, possibly due to higher starch content (Burns *et al.*, 2012). In contrast, fermentation may reduce caloric density and enhance bioactive compounds influencing metabolic parameters (Cani *et al.*, 2012). The study highlights processing methods' impact on cassava peel's effects on BMI, aligning with research on fermented foods modulating gut microbiota and metabolic health (Cani *et al.*, 2012; Kadooka *et al*., 2010). The findings suggest fermented cassava peel may have a milder effect on weight gain compared to non-fermented peel. Further studies are needed to elucidate mechanisms and potential benefits in obesity management.

Conclusion

This study investigated *Lactobacillus* fermented cassava peel's impact on rats' body mass indices (BMI). *Lactobacillus acidophilus* strain DSM20079 was identified as the fermenter. The study showed non-fermented cassava peel promoted more significant BMI increase compared to fermented and control groups. Fermentation mitigated weight gain, suggesting potential benefits for weight management. Processing methods significantly influenced cassava peel's effects on BMI. Fermented cassava peel is recommended as a growth enhancer and for weight management in livestock.

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