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Corollary of *Lactobacillus* Fermented Yam Peel on Blood Lipoproteins and Lymphocytes in Rats

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Abstract

Dyslipidemia and immune dysfunction are major global health concerns, requiring effective, natural interventions. Simultaneously, the disposal of yam peel waste poses significant environmental challenges.The global challenge of agricultural waste and the need for functional nutraceuticals converge in this study, which evaluated the corollary of *Lactobacillus* fermented yam peel (FYP) on blood lipoproteins and lymphocytes in rats. The fermenting agent was molecularly confirmed as *L. acidophilus* strain DSM20079. Rats were fed a standard diet supplemented with FYP, and key health biomarkers were analyzed. The results demonstrated significant, beneficial modulations in serum lipid profiles: the FYP group exhibited statistically significant reductions in Total Cholesterol (134.10 vs. 158.40 mg/dL; $p<0.01$), LDL-C (26.25 vs. 40.15 mg/dL; $p<0.01$), and Triglycerides (91.85 vs. 122.15 mg/dL; $p<0.05$), alongside a significant increase in HDL-C (67.18 vs. 52.60 mg/dL; $p<0.01$). Concurrently, a potent immunostimulatory effect was observed, with the FYP group showing a significantly elevated total lymphocyte count (282.12 ± 1.01) compared to the normal control (152.16 ± 1.02; $p<0.001$), achieving levels comparable to the pharmaceutical immunostimulant levamisole. These findings indicate that FYP acts as a dual-action functional ingredient, concurrently ameliorating dyslipidemia and enhancing cellular immunity. The study concludes that the bioprocessing of yam peel via *Lactobacillus* fermentation successfully valorizes this waste into a bioactive supplement with proven hypolipidemic and immunopotentiating properties, supporting its potential application in sustainable preventive nutrition and animal health.

Keywords: *Lactobacillus, Fermented Yam Peel, Hypolipidemic, Immunostimulation, Lymphocytes, Lipid Profile*

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1. Introduction

The contemporary global health landscape is dominated by a rising prevalence of non-communicable diseases, with metabolic syndrome and associated immune dysregulation posing a significant dual burden. Conditions characterized by dyslipidemia aberrant levels of blood lipoproteins such as elevated low-density lipoprotein (LDL) and reduced high-density lipoprotein (HDL)—are primary drivers of cardiovascular disease, the world's leading cause of mortality (GBD 2019 Risk Factors Collaborators, 2020; Iheukwumere *et al*., 2025a; Dim *et al*., 2025a). Simultaneously, chronic, low-grade inflammation, often stemming from metabolic dysfunction, impairs immune competence, particularly lymphocyte function. Lymphocytes, including T-cells and B-cells, are the cornerstone of adaptive immunity, and their efficacy is critical for pathogen defense and immune surveillance. Nutritional interventions that can simultaneously modulate lipid metabolism and bolster lymphocyte activity are therefore of paramount public health interest. This necessity extends beyond human medicine into animal husbandry, where metabolic health directly impacts productivity, disease resistance, and welfare. The search for safe, natural, and costeffective nutraceuticals capable of addressing these interconnected physiological axes represents a critical frontier in preventive nutrition and functional food science (Iheukwumere *et al.*, 2022a; and Nwike *et al.*, 2017). Parallel to the health imperative is the urgent environmental need to manage agricultural waste through valorization strategies. The processing of root crops like yams (*Dioscorea spp.*) generates substantial volumes of peel, a lignocellulosic by-product typically discarded, leading to environmental pollution and resource loss (Adetuyi et al., 2021; Ekechukwu *et al.*, 2025a; Obianom *et al.*, 2024; Dim *et al.*, 2025b). However, this "waste" contains residual starch, dietary fiber, minerals, and bioactive compounds like diosgenin and polyphenols, which have documented hypolipidemic and antioxidant properties. In its raw form, yam peel's high fiber and antinutrient content limit its bioavailability and palatability for monogastric animals. This creates a classic research opportunity: transforming an environmental liability into a high-value functional ingredient. Bioprocessing via fermentation is recognized as a potent method to enhance the bioaccessibility of bioactive compounds, reduce antinutrients, and generate novel postbiotic metabolites. The successful conversion of yam peel into a functional feed or food additive could thus address both waste management and the demand for health-promoting ingredients, embodying the principles of a circular bio-economy.

The selection of *Lactobacillus* species as fermenting agents is strategic, given their generally recognized as safe (GRAS) status and well-established probiotic functions. Solid-state fermentation with *Lactobacillus* does not merely preserve the substrate; it actively upgrades it through microbial metabolism. The bacteria secrete a consortium of enzymes (e.g., amylases, cellulases, phytases) that break down complex macronutrients, increase soluble fiber content, and degrade antinutritional factors, thereby enhancing overall nutrient digestibility and absorption (Mensah et al., 2020; Iheukwumere *et al*., 2025b; Dim *et al*., 2025c). Crucially, this process generates bioactive metabolites, including short-chain fatty acids (SCFAs) like acetate, propionate, and butyrate, bioactive peptides, and various organic acids. SCFAs, in particular, are known systemic signaling molecules. Propionate, for example, can inhibit hepatic cholesterol synthesis, while butyrate is a potent immunomodulator that can influence lymphocyte differentiation and function within the gut-associated lymphoid tissue (GALT) and systemically. Thus, *Lactobacillus* fermentation is hypothesized to transform yam peel from a fibrous matrix into a rich source of compounds with direct potential to modulate host lipid metabolism and immunology.

The proposed dual modulation of lipoproteins and lymphocytes by fermented yam peel is grounded in interconnected physiological mechanisms. Dietary fiber and SCFAs produced during fermentation can influence lipid metabolism by binding bile acids in the intestine, increasing their fecal excretion, and forcing the liver to utilize circulating cholesterol to synthesize new bile acids, thereby lowering serum LDL-C levels. SCFAs also act as ligands for G-protein-coupled receptors (e.g., GPR43, GPR109A) on immune cells, including lymphocytes, modulating their proliferation, cytokine production, and anti-inflammatory activity (Corrêa-Oliveira et al., 2016). Furthermore, the antioxidant capacity of polyphenols released or formed during fermentation can reduce oxidative stress, a key contributor to the oxidation of LDL particles (making them more atherogenic) and to chronic inflammation that suppresses effective lymphocyte response. Therefore, a *Lactobacillus*-fermented yam peel supplement could theoretically intervene at multiple nodes: reducing atherogenic lipid profiles, quenching oxidative stress, and providing direct microbial metabolites to prime a more robust and balanced lymphocyte population.

Despite the compelling rationale, there is a significant paucity of direct experimental evidence on the systemic effects of *Lactobacillus*-fermented yam peel, particularly its corollary impact on blood lipoproteins and lymphocyte populations in a mammalian model. While some studies have examined fermented feeds for growth performance, research focusing on specific, clinically relevant biomarkers of cardio-metabolic and immune health is lacking. It remains unclear whether the biotransformation process yields a product with significant hypolipidemic and immunostimulatory efficacy *in vivo*. This study is designed to evaluate the corollary of *Lactobacillus* fermented yam peel on blood lipoproteins and lymphocytes in rats.

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^{0}C).

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 yam peel

The yam 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 Chicks: A total of twenty four (24) broiler chicks (3 weeks old) were purchased from poultry market located at Ihiala market, Ihiala L. G. A. in Anambra State were used for the study. The chicks were kept in separate, thoroughly cleaned and disinfected house and provided with feeds and water ad libitum. All the chicks were vaccinated against Newcastle disease using Lasota vaccine strains at 6 and 19 days of age, against infectious bronchitis using live H120 strain at 6 days old and also against avian influenza (A1) disease using inactivated H5N1virus vaccine strain at 7 days old. All the vaccines were given via eye drop instillation except (A1) vaccine, which was given through the subcutaneous route at the back of the neck from the folder report collected from the poultry farmer.

Feed Additive

The fermented groundnut chaff was mixed with fish meal and the feed in a ratio of 1:20. This mixture was properly and thoroughly mixed and administered to the chicks. The chicks were divided into two groups (A and B). Group A was given the feed mixed with the additive whereas Group B was given only the feed. The experimental animals were fed in the morning, afternoon and night together with water for 4 months.

Experimental Protocols for the *In vivo* Models: A total of 36 broiler chicks were used for this study. The broiler chicks were grouped into six groups, and each group comprises 6 chicks. . A 0.5 g/100 g of fermented corn mixed with fish meal was orally administered to each of group of broiler chicks, and the remaining group was giving only feed and water as control group. The body weights and blood absolute lymphocytes were assessed from the blood samples drawn from the chicks after 11 days.

Experimental Protocols for the *In vivo* Models: A total of 36 broiler chicks were used for this study. The broiler chicks were grouped into six groups, and each group comprises 6 chicks. . A 0.5 g/100 g of fermented corn mixed with fish meal was orally administered to each of group of broiler chicks, and the remaining group was giving only feed and water as control group. The body weights and blood absolute lymphocytes were assessed from the blood samples drawn from the chicks after 11 days.

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).

T-cell population: This was carried out using the modified method described and published by Anarthe *et al*. (2014), Iheukwumere *et al*. (2025n). On the 11th day, blood samples were collected from the retro-orbital plexus of the rats (another 4 rats in each group), and these were mixed with Alsever's solution in test tubes. These were kept in a sloping position (45 °) and incubated at 37 °C for 1h. The RBCs were allowed to settle at the bottom of the test tubes, and supernatant was collected from each test tube using a micropipette, and this contains the Lymphocytes. Then 50 µl of Lymphocyte suspension and 50µl of SRBC were mixed in each test tube and incubated at 37 °C for 1h. The resultant suspension in each test tube was centrifuged at 2000 rpm for 5 min and kept in a refrigerator at 4 °C for 2h. The supernatant was removed, and one drop was placed on a clean, grease-free slide. Total Lymphocytes were counted, and a lymphocyte binding with three or more erythrocytes was considered a rosette, and the number of rosettes was counted.

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 microbial agent, designated Isolate P, was initially characterized by its growth and structural features on culture media. It presented as cream-white colonies on MRS agar with a low-convex elevation, smooth margins, and a smooth, transparent surface. Microscopic examination revealed it to be composed of Gram-positive rods. Further testing confirmed it was non-motile and did not produce endospores. This collective morphological and staining profile was strongly indicative of a bacterium belonging to the *Lactobacillus* genus, a group commonly used in fermentation for its safety and probiotic potential.

A series of biochemical tests were conducted to further classify Isolate P. The isolate tested negative for catalase, citrate utilization, oxidase, urease, and gelatin hydrolysis. It also yielded negative results for the Methyl Red and Voges-Proskauer tests. In contrast, it demonstrated a positive ability to ferment key carbohydrates, including glucose, lactose, maltose, and fructose, with variable reactions observed for several other sugars like D-mannitol and trehalose. This specific biochemical signature catalase-negative and fermentative provided strong corroborative evidence that Isolate P was a species of *Lactobacillus*, aligning with the initial morphological observations.

Definitive identification was achieved through genomic analysis. High-quality DNA was successfully extracted, as evidenced by a concentration of 142.40 µg/mL and a 260/280 absorbance ratio of 1.83, confirming the purity of the nucleic acid sample. Sequencing and subsequent BLAST analysis yielded unequivocal results. The analysis returned a maximum score of 6593 with 100% query cover and 100% identity. The probability value (E-value) of 0.0 indicated an extremely high statistical significance for the match, which was to *Lactobacillus acidophilus* strain DSM20079 (Accession CP020620.1). This conclusively identified the fermenting microorganism used in the study.

The effect of the *Lactobacillus*-fermented yam peel diet on lipid metabolism was assessed through serum analysis. The test group of rats exhibited a markedly improved lipid profile compared to the control. A statistically significant reduction was observed in total cholesterol (CT) and low-density lipoprotein cholesterol (LDL-C) levels ($p < 0.01$). Concurrently, there was a statistically significant increase in high-density lipoprotein cholesterol (HDL-C) in the test group ($p < 0.01$). Serum triglycerides (TG) were also significantly lower in the test group ($p < 0.05$). These shifts collectively indicate a potent hypolipidemic and cardio-protective effect induced by the fermented dietary intervention.

The immunomodulatory impact of the supplement was evaluated by measuring total lymphocyte levels. Rats in the test group, which received the fermented yam peel, demonstrated a mean lymphocyte count of 282.12 ± 1.01. This value was significantly higher ($p < 0.001$) than the baseline level in the normal control group (152.16 ± 1.02) and dramatically higher than the immunosuppressed group treated with dexamethasone (113.82 ± 1.12). Notably, the lymphocyte count in the test group was statistically comparable to, and even slightly exceeded, that of the positive control group treated with the known immunostimulant levamisole (273.15 ± 1.21), indicating a powerful immunopotentiating effect.

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: Lipid profiles of rats

Parameter	Control group	Test group
CT (mg/dL)	158.40	134.10
LDL – C (mg/dL)	40.15	26.25
HDL-C (mg/dL)	52.60	67.18
TG (mg/dL)	122.15	91.85

Table 6: Total lymphocyte level

Group	Dose (mg/g)	Mean lymphocytes
Control (Normal)	-	152.16 ± 1.02
Control (Dexamethasome)	200	113.82 ± 1.12
Control (Levamisole)	50	273.15 ± 1.21
Test	100	282.12 ± 1.01

DISCUSSION

The unequivocal identification of the fermenting microorganism as *Lactobacillus acidophilus* strain DSM20079 is a critical first step that validates the experimental model. Utilizing a well-characterized, GRAS-status probiotic ensures the safety of the fermentation process and allows for the attribution of biological effects to a specific, reproducible agent. This approach aligns with contemporary research standards advocated by Jazi et al. (2017), who emphasize the importance of defined microbial cultures over undefined consortia for consistent and interpretable outcomes in functional feed studies. The molecular confirmation (100% identity, E-value 0.0) provides a robust foundation, ensuring that the observed physiological effects in rats can be reliably linked to the metabolic activity and postbiotic production of this specific *Lactobacillus* strain, a factor often overlooked in similar agro-waste valorization studies.

The pronounced improvement in the serum lipid profile marked by significant reductions in total cholesterol, LDL-C, and triglycerides alongside a significant increase in HDL-C represents a core finding of this study. This hypolipidemic effect strongly agrees with the proposed bioactive potential of fermented plant substrates. Researchers like Mensah et al. (2020) have documented that *Lactobacillus* fermentation of yam peel increases soluble fiber and bioactive metabolites. The observed lipid-lowering effects are likely mediated by multiple mechanisms: soluble fiber binding bile acids for excretion, forcing hepatic cholesterol use for bile acid synthesis; and microbial short-chain fatty acids (SCFAs) like propionate directly inhibiting hepatic cholesterolgenesis. Our results corroborate the findings of Adebiyi et al. (2022), who noted similar metabolic improvements from fermented agro-byproducts, validating the concept that bioprocessing can unlock plant-based compounds with significant lipid-modulating activity.

The dramatic and significant increase in total lymphocyte count in the test group, achieving levels comparable to the established immunostimulant levamisole, indicates a powerful immunopotentiating effect. This finding is highly significant and agrees with the growing body of research on the immunomodulatory role of probiotic metabolites. Gadde et al. (2017) highlighted that probiotics and their fermentation products can enhance gut-associated lymphoid tissue (GALT) activity, leading to systemic immune effects. The SCFAs (particularly butyrate) and bioactive peptides produced during *Lactobacillus* fermentation are known to influence lymphocyte proliferation, differentiation, and homing. Our results provide direct *in vivo* evidence that fermented yam peel can act as an effective immunostimulant, potentially offering a natural alternative to pharmaceutical agents like levamisole, which can have residue and resistance concerns.
The most compelling aspect of this study is the demonstration of a corollary effect—simultaneous improvement in both lipid metabolism and immune parameters. This dual action is biologically plausible and highly synergistic. Chronic dyslipidemia and associated oxidative stress are known to suppress immune function and promote a pro-inflammatory state. By ameliorating the lipid profile and likely reducing systemic oxidative stress (via antioxidant compounds in fermented peel), the dietary intervention may have created a physiological environment more conducive to robust lymphocyte proliferation. This interconnected outcome supports the holistic "gut-systemic axis" model proposed by researchers like Corrêa-Oliveira et al. (2016), where fermented, fiber-rich diets modulate host physiology through microbial metabolites, benefiting multiple organ systems concurrently. Our findings empirically validate this model in the context of a specific valorized waste product.
It is noteworthy that this study found significant positive effects on blood biomarkers, whereas other research on similar fermented ingredients, such as our earlier work on organ weight and function in rats, showed neutral (i.e., safe) results. This contrast does not represent a disagreement but rather highlights the specificity of the biological response. An ingredient can be physiologically safe (causing no organ damage) while also being functionally bioactive (modifying specific metabolic and immune pathways). The current findings on lipoproteins and lymphocytes thus complement and extend the safety profile by demonstrating active health-promoting properties. This aligns with the broader literature where fermented feeds show variable effects primarily on performance and specific blood parameters without inducing toxicity.

CONCLUSION

Lactobacillus acidophilus-fermented yam peel demonstrated significant dual bioactive properties in a rat model, effectively improving serum lipid profiles and stimulating lymphocyte proliferation. These findings validate its successful transformation from agricultural waste into a functional ingredient with hypolipidemic and immunopotentiating effects. The results support its potential application as a sustainable nutraceutical in animal and human nutrition. Further research is warranted to elucidate the precise mechanisms of action and determine optimal dosage protocols. This study contributes a compelling case for the valorization of agro-byproducts through probiotic fermentation.

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Conflict of interests

The authors declare that they have no conflict of interests.

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REFERENCES

Adebiyi, O. A., Olaniran, A. O., & Okoh, A. I. (2022). Nutritional upgrading of agro-industrial wastes through fermentation: Impacts on animal performance and health. *Journal of Animal Science and Technology, 64*(3), 489–503.

Adetuyi, B. O., Dairo, J. O., & Oluwaferanmi, O. M. (2021). Yam peel utilization: A review of its potential in food, feed, and biofuel applications. *Journal of Food Science and Technology, 58*(10), 3649-3661.

Alabi, O. J., Malik, A. D., Ngambi, J. W., Obaje, P., and Ojo, B. K. (2017). Effect of aqueous Moringa oleifera leaf extract on growth performance, haematology and serum biochemistry of broiler chickens. *Livestock Research for Rural Development*, 29(12), 1–8.

Alahyaribeik, S., Nazarpour, M., Tabandeh, F., Honarbakhsh, S., & Sharifi, S. D. (2022). Effects of bioactive peptides derived from feather keratin on plasma cholesterol level, lipid oxidation of meat, and performance of broiler chicks. *Tropical Animal Health and Production*, *54*(5), 271.

Amadi, R.E., Iheukwumere, I.H. and Unaeze, B.C. (2017). Effects Of Crude Alkaloid Extracted From Ocimum Gratissimum On The Activity Of Ciprofloxacin Against Salmonella Enterica Serovar Typhi. *Advances in Life Science and Technology* 58.

Anahtar, M. N., Byrne, E. H., Doherty, K. E., Bowman, B. A., Yamamoto, H. S., Soumillon, M., ... and Kwon, D. S. (2018). Cervicovaginal bacteria are a major modulator of host inflammatory responses in the female genital tract. *Immunity, 42*(5), 965-976. https://doi.org/10.1016/j.immuni.2015.04.019

Balogu, T. V., Ibrahim, H., & Balogu, D. O. (2017). Nutritionally improved corn mill waste (chaff) with microbial protein: An economic alternative for poultry feed. *Advances in Applied Sciences*, *2*(2), 18-22.

Bell, V., Ferrão, J., & Fernandes, T. (2017). Nutritional guidelines and fermented food frameworks. *Foods, 6*(8), 65. https://doi.org/10.3390/foods6080065

Cabel, M. C., Goodwin, T. L., & Waldroup, P. W. (1988). Feather meal as a nonspecific nitrogen source for abdominal fat reduction in broilers during the finishing period. *Poultry Science*, *67*(2), 300-306.

Cai, Y., Li, Y., Zhang, Y., & Wang, Y. (2019). The role of *Lactobacillus* in immune regulation: Current status and perspectives. *Frontiers in Immunology*, *10*, 1804. https://doi.org/10.3389/fimmu.2019.01804

Chachaj, R., Sembratowicz, I., Krauze, M., & Ognik, K. (2019). The effect of partial replacement of soybean meal with fermented soybean meal on chicken performance and immune status. *Journal of Animal and Feed Sciences*, *28*(3), 263-271.

Chen, M., Sun, Q., & Giovannucci, E. (2021). Dairy consumption and risk of type 2 diabetes: The role of fermented dairy products. *American Journal of Clinical Nutrition, 113*(5), 1100–1111. https://doi.org/10.1093/ajcn/nqaa397

Chude,C.O., Iheukwumere, I.H., Iheukwumere, C.M., Nwaolisa,C.N., Egbuna, C.,Nwakoby, N.E.and Egbe, P.A. (2020). Cidal activity of proteins secreted by *Bacillus thuringensis* against *Ascaris lumbricoides. International Journal of Research Publications* 49(1): 1033 – 1045.

Corrêa-Oliveira, R., Fachi, J. L., Vieira, A., Sato, F. T., & Vinolo, M. A. (2016). Regulation of immune cell function by short-chain fatty acids. *Clinical & Translational Immunology*, *5*(4), e73.

Corrêa-Oliveira, R., Fachi, J. L., Vieira, A., Sato, F. T., & Vinolo, M. A. (2016). Regulation of immune cell function by short-chain fatty acids. *Clinical & Translational Immunology*, *5*(4), e73.

Cristofori, F., Dargenio, V. N., Dargenio, C., Miniello, V. L., Barone, M., & Francavilla, R. (2021). Anti-inflammatory and immunomodulatory effects of probiotics in gut inflammation: A door to the future. *Frontiers in Immunology, 12*, 578386. https://doi.org/10.3389/fimmu.2021.578386

Dim, C. N., Iheukwumere, I. H., Iheukwumere, C. M., Ugwu, C. H., Ike, V. E., Ezendianefo, . J. N., Egbe, P. A., Oragwu, I. P., Orji, C. C., Ogbonnaya, O. C., Onwuasoanya, U. F., Okereke, F. O., Oduenyi, P. M., & Ochibulu, S. C. (2025a). Multiple Antibiotic Resistance Bacterial Strains in Frozen Meat Sold at Abagana, Anambra State: A Public Health Concern. *IPS Journal of Applied Microbiology and Biotechnology*, *4*(3), 181–186. https://doi.org/10.54117/ijamb.v4i3.75

Dim, C. N., Iheukwumere, I. H., Iheukwumere, C. M., Ugwu, C. H., Ike, V. E., Ezendianefo, J. N., Egbe, P. A., Oragwu, I. P., Orji, C. C., Ogbonnaya, O. C., Onwuasoanya, U. F., Okereke, F. O., Oduenyi, P. M., & Ochibulu, S. C. (2025b). The Burden of Antibiotic Resistance: Evaluating the Impact of Multiple Antibiotic-Resistant Enteric Bacteria in Academic Environments. *IPS Interdisciplinary Journal of Biological Sciences*, *4*(4), 144–149. https://doi.org/10.54117/iijbs.v4i4.78

Dim, C. N., Iheukwumere, I. H., Iheukwumere, C. M., Ugwu, C. H., Ike, V. E., Ezendianefo, J. N., Egbe, P. A., Oragwu, I. P., Orji, C. C., Ogbonnaya, O. C., Onwuasoanya, U. F., Okereke, F. O., Oduenyi, P. M., & Ochibulu, S. C. (2025c). Antimicrobial resistance in aquaculture: evaluating pseudomonas aeruginosa from fish ponds. *IPS Intelligentsia Multidisciplinary Journal*, *4*(1), 32–36. https://doi.org/10.54117/iimj.v4i1.10

Dimidi, E., Cox, S. R., Rossi, M., & Whelan, K. (2019). Fermented foods: Definitions and characteristics, impact on the gut microbiota and effects on gastrointestinal health and disease. *Nutrients, 11*(8), 1806. https://doi.org/10.3390/nu11081806

Egbe, P. A., Umeaku, C. N., Iheukwumere, I. H., Iheukwumere, C. M., Onwuasoanya, U. F., Ezenwata, I. S., Afulukwe, S. C., Ike, V. E., & Ezeumeh, E. N. (2025a). Antibiotic Susceptibility of Helicobacter pylori Isolates from Patients at Nnewi Teaching Hospital, Anambra State. *IPS Journal of Basic and Clinical Medicine*, 2(2), 51–57. https://doi.org/10.54117/ijbcm.v2i2.11.

Egbe, P. A., Umeaku, C. N., Iheukwumere, I. H., Iheukwumere, C. M., Onwuasoanya, U. F., Ezenwata, I. S., Afulukwe, S. C., Ike, V. E., Ezeumeh, E. N., & Egbuna, C. (2025b). Helicobacter pylori Inhibition by Medicinal Plant Extracts: An In Vitro Assessment. IPS Journal of Drug Discovery Research and Reviews, 3(1), 32–37. https://doi.org/10.54117/ijddrr.v3i1.28.

Egbe, P. A., Umeaku, C. N., Iheukwumere, I. H., Iheukwumere, C. M., Onwuasoanya, U. F., Ezenwata, I. S., Afulukwe, S. C., Ike, V. E., & Ezeumeh, E. N. (2025c). Medicinal Plant Extracts Enhance Conventional Antibiotic Activity against Helicobacter pylori: An In Vitro Assessment. IPS Interdisciplinary Journal of Biological Sciences, 4(2), 93–99. https://doi.org/10.54117/iijbs.v4i2.51.

Ejike, C.E., Iheukwumere, I.H. and Armadi, R.E. (2017). Susceptibility of Escherichia coli Isolated from Oligospermia Patient to *Gongronema latifolium* leaves extract. J. *Biol. Agriculture. Healthcare* 7(14).

Ekechukwu, C. C., Umeh, S. O., Iheukwumere, I. H., & Iheukwumere, C. M. (2025a). Bacterial Loads of Smoked Fish and Chicken: Role of pH and Moisture Content. *IPS Applied Journal of Nutrition, Food and Metabolism Science*, 3(1), 44–49. https://doi.org/10.54117/iajnfms.v3i1.102.

Ekechukwu, C. C., Umeh, S. O., Iheukwumere, I. H., & Iheukwumere, C. M. (2025b). Biological Inhibition of Pathogenic Bacteria Isolated from Smoked Fish and Chicken: An In Vitro Study. IPS Interdisciplinary Journal of Biological Sciences, 4(2), 85–92. https://doi.org/10.54117/iijbs.v4i2.50.

Ekechukwu, C. C., Umeh, S. O., Iheukwumere, I. H., & Iheukwumere, C. M. (2025c). Prophylactic Potential of the Most Potent Synergistic Biological Agent against Bacterial Infections from Smoked Fish and Chicken. IPS Journal of Applied Microbiology and Biotechnology, 4(2), 153–160. https://doi.org/10.54117/ijamb.v4i2.57.

Ekesiobi, A. O., Iheukwumere, C. M., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Ike, V. E., Okereke, F. O., & Ochibulu, S. C. (2025). Hyping the Inhibitory Activity of Xylopia aethiopica against Vibrio cholerae using Azithromycin. IPS Journal of Basic and Clinical Medicine, 2(3), 93–98. https://doi.org/10.54117/ijbcm.v2i3.16

Ezedianafo, J. N., Iheukwumere, I. H., Iheukwumere, C. M., Okolo, O., Nwike, I., & Ubajekwe, C. C. (2025a). *Musca domestica*: A vector of multidrug-resistant enteric bacteria. *Journal of Veterinary, Allied, and One Health Sciences, 1*(2), 30–38. https://doi.org/10.54117/3vwg0p36

Ezedianafo, J. N., Iheukwumere, I. H., Iheukwumere, C. M., Okolo, O., Nwike, I., & Ubajekwe, C. C. (2025b). Occurrences of meropenem- and imipenem-resistant *Klebsiella pneumoniae* in *Musca domestica* in hospital landfills. *African Journal of Applied Research & Sustainable Development, 1*(2), 25–35. https://doi.org/10.54117/wjmnyv91

Ezendianefor, J. N., Iheukwumere, I. H., Iheukwumere, C. M., Okolo, O., Nwike, I., & Ubajekwe, C. C. (2025). Multiple antibiotic resistance indices of enteric bacteria isolated from *Musca domestica*. *Journal of Public Health, Policy, and Society, 1*(2), 29–37. https://doi.org/10.54117/k8r78723

Ezendianefor, J. N., Iheukwumere, I. H., Iheukwumere, C. M., Okolo, O., Nwike, I., & Ubajekwe, C. C. (2025). *Klebsiella pneumoniae* isolated from *Musca domestica*: Antibiotic susceptibility and resistance patterns. *Journal of Veterinary, Allied, and One Health Sciences, 1*(2), 39–47. https://doi.org/10.54117/vy6y8f94

Ezendianefor, J. N., Iheukwumere, I. H., Iheukwumere, C. M., Okolo, O., Nwike, I., & Ubajekwe, C. C. (2025). *Musca domestica* as vectors of pathogenic enteric bacteria: A public health concern. *African Journal of Applied Research & Sustainable Development, 1*(2), 36–45. https://doi.org/10.54117/s671mk28

Frias, J., Peñas, E., & Martínez-Villaluenga, C. (2017). Fermented foods in health promotion and disease prevention. In V. R. Preedy & R. R. Watson (Eds.), *Fermented Foods in Health and Disease Prevention* (pp. 3–20). Academic Press.

Gadde, U., Kim, W. H., Oh, S. T., & Lillehoj, H. S. (2017). Alternatives to antibiotics for maximizing growth performance and feed efficiency in poultry: a review. *Animal Health Research Reviews, 18*(1), 26–45.

GBD 2019 Risk Factors Collaborators. (2020). Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet, 396*(10258), 1223-1249.

Guo, Q., Goldenberg, J. Z., Humphrey, C., El Dib, R., Johnston, B. C., & Lo, C. K. F. (2020). Probiotics for the prevention of pediatric antibiotic-associated diarrhea. *Cochrane Database of Systematic Reviews, 4*(4), CD004827. https://doi.org/10.1002/14651858.CD004827.pub5

Guo, S., Zhang, Y., Cheng, Q., Xv, J., Hou, Y., Wu, X., Du, E., & Ding, B. (2020). Partial Substitution of Fermented Soybean Meal for Soybean Meal Influences the Carcass Traits and Meat Quality of Broiler Chickens. *Animals, 10*(2), 225. https://doi.org/10.3390/ani10020225

Hidayat, C., Darmawan, A., Astuti, D. A., Supriyati, S., and Wina, E. (2021). The role of short-chain fatty acids in lipid metabolism of poultry: A review. *Veterinary World*, 14(4), 1079–1087. https://doi.org/10.14202/vetworld.2021.1079-1087

Hill, C., Guarner, F., Reid, G., Gibson, G. R., Merenstein, D. J., Pot, B., ... and Sanders, M. E. (2014). Expert consensus document: The International Scientific Association for Probiotics and Prebiotics consensus statement on the scope and appropriate use of the term probiotic. *Nature Reviews Gastroenterology and Hepatology, 11*(8), 506-514. https://doi.org/10.1038/nrgastro.2014.66

Husnain, A., Anwar, U., Fatima, A., Mustafa, R., Farooq, U., Abbas, W., Khalid, M. F., Ashraf, M., & Aziz ur Rahman, M. (2025). Effects of replacement of soybean meal with fermented soybean meal on growth performance, nutrient digestibility and carcass characteristics in broiler. *Livestock Science, 299*, 105779. https://doi.org/10.1016/j.livsci.2025.105779

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Bacterial symbionts of *Rhynchophorus phoenicis*: Modulation of rat lymphocyte function and immunity. *Journal of Tropical Medicine and Public Health Solutions, 1*(2), 55–63. https://doi.org/10.54117/jtmphs.v1i2.36

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Multidrug-resistant *Klebsiella pneumoniae* in *Musca domestica*: A potential public health threat. *Journal of Tropical Medicine and Public Health Solutions, 1*(2), 46–54. https://doi.org/10.54117/jtmphs.v1i2.35

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Termite-derived antimicrobials: A novel approach to control *Bacillus cereus* in food products. *International Journal of Global Trends and Research, 1*(2), 45–57. https://doi.org/10.54117/2mgwn270

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Bacterial diversity in insect guts and their potential applications in industry. *International Journal of Global Trends and Research, 1*(2), 36–44. https://doi.org/10.54117/2k0d9t18

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Bioactive compounds from *Macrotermes*: A novel approach to combat multidrug resistant *Klebsiella pneumoniae* from *Musca domestica* in hospital landfills. *IPS Journal of Biotechnology and Applied Biochemistry, 1*(2), 82–92. https://doi.org/10.54117/ijbab.v1i2.111

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Assessment of blood indices in rats supplemented with Macrotermes-derived nutrient-enhanced bacteria. *IPS Journal of Basic and Clinical Medicine, 2*(4), 143–151. https://doi.org/10.54117/ijbcm.v2i4.39

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Exploring the potential of termite gut bacteria as growth promoters and organ function enhancers in albino Wistar rats. *Health Science Research International, 1*(2), 43–52. https://doi.org/10.54117/hsri.v1i2.38

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Assessment of hematological parameters in albino Wistar rats fed with *Rhynchophorus phoenicis* larvae enriched with autochthonous bacteria. *Health Science Research International, 1*(2), 34–42. https://doi.org/10.54117/hsri.v1i2.37

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Entomopathogenic bacteria-mediated management of *Delia radicum*: A step towards eco-friendly pest control. *Journal of Agriculture, Food Technology and Sustainability, 2*(2), 112–121. https://doi.org/10.54117/jafts.v2i2.110

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Antimicrobial activity of Macrotermes-derived eluates against multidrug resistant Pseudomonas species: Implications for aquaculture disease management. *Journal of Agriculture, Food Technology and Sustainability*, *2*(2), 102–111. https://doi.org/10.54117/jafts.v2i2.109

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Exploring the potential of entomopathogenic bacteria for sustainable management of *Sitophilus zeamais* in maize storage systems. *IPS Journal of Plant, Animal, and Environmental Sciences, 1*(1), 11–20. https://doi.org/10.54117/ijpae.v1i1.108

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Biological control of *Acanthoscelides obteus* using entomopathogenic bacteria. *IPS Journal of Plant, Animal, and Environmental Sciences, 1*(1), 1–10. https://doi.org/10.54117/ijpae.v1i1.107

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Modulation of phagocytic index in albino Wistar rats via bacterial symbionts from *Rhynchophorus phoenicis* larvae. *African Journal of Nutrition and Applied Research, 1*(2), 27–36. https://doi.org/10.54117/fm3vgt16

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Bacterial symbionts of insect larvae: A novel approach to improving micronutrient content. *African Journal of Nutrition and Applied Research, 1*(2), 27–36. https://doi.org/10.54117/960k2266

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Unlocking the potential of termite gut microbiome: Enhancing nutritional value through bacterial symbionts. *IPS Journal of Nutrition and Food Science*, *5*(1), 636–645. https://doi.org/10.54117/ae6gj081

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Enhancing nutritional parameters with bacterial symbionts from Macrotermes species: A potential frontier in nutritional biotechnology. *IPS Journal of Nutrition and Food Science, 5*(1), 625–635. https://doi.org/10.54117/a2b7jb52

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Bacterial symbionts of Macrotermes species: Assessing their impact on phagocytic indices of albino Wistar rats. *IPS Interdisciplinary Journal of Biological Sciences, 5*(1), 187–196. https://doi.org/10.54117/iijbs.v5i1.106

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Bacterial symbionts of insects: Exploring their role in insect nutritional composition. *IPS Interdisciplinary Journal of Biological Sciences, 5*(1), 177–186. https://doi.org/10.54117/iijbs.v5i1.105

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Augmenting rat lymphocyte function by bacterial symbiont of Macrotermes species. *IPS Journal of Applied Microbiology and Biotechnology, 5*(1), 281–290. https://doi.org/10.54117/ijamb.v5i1.104

Idigo, M. A., Iheukwumere, I. H., Iheukwumere, C. M., Nnaeze, B. C., Akulue, C. J., Nwakoby, N. E., Ezendianefor, J. N., Ike, V. E., Nnaedozie, A. O., Ezekwueche, S. N., Anagor, I. S., Aniekwe, C. C., Ezeoke, F. C., Okereke, F. O., & Ochibulu, S. C. (2025). Antimicrobial peptides from insects: A study on their efficacy against pathogens. *IPS Journal of Applied Microbiology and Biotechnology, 5*(1), 271–280. https://doi.org/10.54117/ijamb.v5i1.103

Iheukwumere, C. M., & Iheukwumere, I. H. (2022a). Nutritive and Antinutrient Values of Soybean Condiments Produced from Indigenous Fermenters. *IPS Applied Journal of Nutrition, Food and Metabolism Science*, 1(1): 1-5. https://doi.org/10.54117/iajnfms.v1i1.8

Iheukwumere, C. M., & Iheukwumere, I. H. (2022e). Hematological indices and sensory quality of fermented soybean condiments. *World Journal of Advanced Research and Reviews*, 14(2), 435-42

Iheukwumere, C. M., Ekesiobi, A. O., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Dim, C. N., & Ochibulu, S. C. (2025g). Dual Approach Therapy: Assessing Xylopia aethiopica and Ciprofloxacin Synergy against Salmonella enterica Serovar Typhi. *IPS Intelligentsia Multidisciplinary Journal*, *4*(1), 27–31. https://doi.org/10.54117/iimj.v4i1.9.

Iheukwumere, C. M., Ekesiobi, A. O., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Dim, C. N., Ochibulu, S. C., Unegbu, C. C., & Egbuna, C. (2025h). Food Safety Implications: Assessing the Potential of Desmodium velutinum Leaves Extracts to Control the Most Predominant Fungal Contamination in Ready-To-Eat Fried Chicken. *IPS Journal of Nutrition and Food Science*, *4*(3), 494–500. https://doi.org/10.54117/ijnfs.v4i3.111

Iheukwumere, C. M., Iheukwumere, I. H., Nwakoby, N. E., Idigo, M. A., & Ike, V. E. (2025m). Evaluation of fermented chicken feather meal as a dietary supplement on rat lipid metabolism and immune response. *African Journal of Nutrition and Applied Research*, *1*(1), 17–26. https://doi.org/10.54117/qbwbpp15

Iheukwumere, C. M., Iheukwumere, I. H., Okoli, U. O., & Ugwu, C. H. (2023a). Immunological Impact of Fermented Soybean Condiments Produced from Indigenous Fermenters. *Journal of Advances in Microbiology* 23(10): 27-37

Iheukwumere, C. M., Iheukwumere, I. H., Ugwu, C. H., & Okoli, U. O. (2023b). Toxicity of Prepared Fermented Soybean Condiments from Indigenious Fermenters. *Journal of Advances in Microbiology* 23(10): 38 – 51.

Iheukwumere, C. M., Umeaku, C. N., Chukwura, E. N., & Iheukwumere, I. H. (2022f). Characterization of the indigenous fermenters for the production of fermented condiments from soybean seeds. *World Journal of Advanced Research and Reviews*, *14*(2), 423-434.

Iheukwumere, I. H., & Ejike, C. E. (2017b). Comparative study of the inhibitory activities of Ocimum gratissimum and Nepeta cataria against Salmonella enterica serovar Typhi and their larvicidal effect against Anopheles gambiae. *African Journal of Education, Science and Technology (AJEST)*, *3*(4), 16-24

Iheukwumere, I. H., Ajeh, J. C., Iheukwumere, C. M., Ike, V. E., Obianom, A. O., Ihenatuoha, U. A. ., Igboanugo, E. U., Onwuasoanya, U. F., Okereke, F. O., Nnadozie, C. H., Agbaugo, C. F., Nwike, M. I., Nwakoby, N. E., & Ilechukwu, C. C. (2025c). Exploring the Phytochemical and Antimicrobial Properties of Fruit Vinegar: A Study on Phoenix Dactylifera and Malus Sylvestris. *IPS Journal of Applied Microbiology and Biotechnology*, 4(1), 115–122. https://doi.org/10.54117/ijamb.v4i1.48

Iheukwumere, I. H., Ajeh, J. C., Iheukwumere, C. M., Ike, V. E., Obianom, A. O., Ihenatuoha, U. A., Igboanugo, E. U., Onwuasoanya, U. F., Okereke, F. O., Nnadozie, C. H., Agbaugo, C. F., Nwike, M. I., Nwakoby, N. E., & Ilechukwu, C. C. (2025d). Microbial Quality and Sensory Assessment of Vinegar from Date Palm and Apple Fruits:

Implications for Consumer Preference. IPS Journal of Nutrition and Food Science, 4(2), 410–417. https://doi.org/10.54117/ijnfs.v4i2.100.

Iheukwumere, I. H., Ajeh, J. C., Iheukwumere, C. M., Ike, V. E., Obianom, A. O., Ihenatuoha, U. A., Igboanugo, E. U., Onwuasoanya, U. F., Okereke, F. O., Nnadozie, C. H., Nwike, M. I., Nwakoby, N. E., & Ilechukwu, C. C. (2025f). Safety Evaluation of Vinegar from Phoenix Dactylifera and Malus Sylvestris: Toxicity and Acetic Acid Content. IPS Journal of Applied Microbiology and Biotechnology, 4(1), 123–131. https://doi.org/10.54117/ijamb.v4i1.49

Iheukwumere, I. H., Ajeh, J. C., Iheukwumere, C. M., Ike, V. E., Obianom, A. O., Ihenatuoha, U. A ., Igboanugo, E. U., Onwuasoanya, U. F., Okereke, F. O., Nnadozie, C. H., Agbaugo, C. F., Nwike, M. I., Nwakoby, N. E., & Ilechukwu, C. C. (2025k). Exploring the Phytochemical and Antimicrobial Properties of Fruit Vinegar: A Study on Phoenix Dactylifera and Malus Sylvestris. *IPS Journal of Applied Microbiology and Biotechnology*, 4(1), 115–122. https://doi.org/10.54117/ijamb.v4i1.48

Iheukwumere, I. H., Amadi, E. R., & Chude, C. (2018b). Synergistic Effects of Probiotics and Autogenous Bacterin Against Inositol Negative Motile Salmonella Species. *Journal of Biology, Agriculture and Healthcare* 8(6).

Iheukwumere, I. H., Amadi, R. E., Unaeze, B. C., & Campus, N. (2017c). Enterotoxigenicity Profile of Salmonella Enterica Serovar Typhimurium in Suckling Albino Mice. Journal of Natural Sciences Research 7(14).

Iheukwumere, I. H., Chukwura, E. I., & Chude, C. (2018c). In vivo activities of some selected antimicrobial agents against enteric bacteria isolated from chicken feeds on broiler layers. *Journal of Biology, Agriculture and Healthcare*, *8*(6).

Iheukwumere, I. H., Ejike, C. E., & Okeke, C. E. (2017d). A trial to prevent sorbitol negative Escherichia coli infections in chicks using autogenous bacteria and probiotics. *Journal of Natural Sciences Research*, *7*, 56-63.

Iheukwumere, I. H., Iheukwumere, C. M., Obianom, A. O., Nnadozie, C. H., Okereke, F. O., Onwuasoanya, U. F., … Ihenatuoha, U. A. (2025a). Cross-Sectional Study of Different Strains of Bacillus cereus among Pap Sold in Major Towns in Ihiala LGA, Anambra State. IPS Journal of Public Health, 5(2), 199–204. https://doi.org/10.54117/ijph.v5i2.39.

Iheukwumere, I. H., Iheukwumere, C. M., Obianom, A. O., Nnadozie, C. H., Okereke, F. O., Onwuasoanya, U. F., … Destiny, E. C. (2025b). Cross-Sectional Study of Major Strains of Salmonella enterica Subspecies Enterica Serovar Typhi among Borehole Used in Uli Community. IPS Journal of Public Health, 5(2), 205–210. https://doi.org/10.54117/ijph.v5i2.40.

Iheukwumere, I. H., Iheukwumere, C. M., Obianom, A. O., Nnadozie, C. H., Okereke, F. O., Onwuasoanya, U. F., Udeagbara, O. E., Unaeze, B. C., Obiefuna, O. H., Ike, V. E., Onyemekara, N. N., & Ihenatuoha, U. A. (2025e). Quotidian of Substantial Strain of Shigella dysenteriae among Ready To-Eat Fruit Salad Sold in Uli Community. Journal of Pollution Monitoring, Evaluation Studies and Control, 4(1), 95–99. https://doi.org/10.54117/jpmesc.v4i1.17

Iheukwumere, I. H., Iheukwumere, C. M., Obianom, A. O., Nnadozie, C. H., Okereke, F. O., Onwuasoanya, U. F., … Ihenatuoha, U. A. (2025i). Cross-Sectional Study of Different Strains of Bacillus cereus among Pap Sold in Major Towns in Ihiala LGA, Anambra State. IPS Journal of Public Health, 5(2), 199–204. https://doi.org/10.54117/ijph.v5i2.39.

Iheukwumere, I. H., Iheukwumere, C. M., Obianom, A. O., Nnadozie, C. H., Okereke, F. O., Onwuasoanya, U. F., … Destiny, E. C. (2025j). Cross-Sectional Study of Major Strains of Salmonella enterica Subspecies Enterica Serovar Typhi among Borehole Used in Uli Community. IPS Journal of Public Health, 5(2), 205–210. https://doi.org/10.54117/ijph.v5i2.40.

Iheukwumere, I. H., Iheukwumere, M. C., & Nwakoby, N. E. (2022d). Sequential Pathogenicity Study of SOR+ and SOR-Escherichia coli Isolated from Roasted Meat. *IPS Intelligentsia Multidisciplinary Journal*, *1*(1), 1-11.

Iheukwumere, I. H., Nwankwo, A. K., Iheukwumere, C. M., Okorie, N. A., Nwakoby, N. E.,. Ekesiobi, A. O. and Okolo, O. C.. (2025n). Characterization and pathogenic profile of *Aspergillud fumigatus* isolated from lendfills. *Microbes and Infectious Diseases* 6(4)

Iheukwumere, I. H., Obi, P. C. and Unaeze, B. C. (2017a). A trial to prevent *Vibrio cholerae* in albino mice using autogenous bacterin. *Advances in Life Science and Technology* 58:34–42

Iheukwumere, I. H., Uneze, B. C., & Ejike, C. E. (2017e). Efficacy of some selected antimicrobial substances in prevention of enteric bacterial infection in broiler chicks. *J. Biol. Agriculture. Healthcare*, *7*, 58-66.

Iheukwumere, I.H. , Iheukwumere, C.M. , Nnadozie, H. C. ,Unaeze, C.B. , Obiefuna, O.H. Obianom, A.O. and Ejike, C. E. (2024). Hematotoxicological and mosquito larvicidal studies of crystal proteins secreted by Bacillus thuringiensis and Bacillus sphaericus. *Tropical Journal of Applied Natural Sciences* 2(2): 61 – 92.

Iheukwumere, I.H. and Iheukwumere, M.C. (2022c). Streptococcus suis in Pigs and Environs: A Cross-sectional Study. IPS Journal of Public Health, 1(2), 9-12. https://doi.org/10.54117/ijph.v1i2.4.

Iheukwumere, I.H. and Iheukwumere, M.C. (2022g). Cross-sectional Study of Multiple Antibiotic-resistant Streptococcus suis in Pigs and Environments. IPS Interdisciplinary Journal of Biological Sciences, 1(1), 19–21. https://doi.org/10.54117/iijbs.v1i1.4

Iheukwumere, I.H., Dimejesi, S.A.,Iheukwumere, C.M., Chude, C.O., Nwaolisa, C.N.,Ukoha, C.C., Nwakoby,N.E., Egbuna, C. and Egbe, P.A. (2020) Diversity and molecular characterization of keratinophilic fungi from soil samples. *International Journal of Research Publication* 50(1); 1047 -1062.

Iheukwumere, I.H., Iheukwumere, M.C. and Nwakoby, N.E. (2022b). Synergistic Effects of Probiotics and Autogenous Bacterin against Salmonella enterica Serovar Typhimurium Strain U288. IPS Journal of Nutrition and Food Science, 1(1), 1–5. https://doi.org/10.54117/ijnfs.v1i1.3.

Iheukwumere, I.H., Nwike, M. I., Iheukwumere, C.M., Ike, V.E., Obianom, A.O., Ihenatuoha, U.A., Igboanugo, E.U., Ekesiobi, A.O., Okereke, F.O., Obiefuna, O. H. Nnadozie, C.H., Agbaugo, C.F., Oduoye, O.T., Nwakoby, N.E., Ilechukwu, C. C.,, Ochibulu, S. C. and Ejike, C. E. (2025l). Extraction and Elucidation of Antibiotics from the Mycelia of Aspergillus niger Isolated from Poultry Farm against Enteric Bacterial Pathogens. *IPS Journal of Advanced and Applied Biochemistry*, 1(1), 1–10. https://doi.org/10.54117/ijaab.v1i1.58.

Iheukwumere,I.H., Iheukwumere,C.M., Chude, C.O., Nwaolisa,C.N. and Egbe, P.A. (2020a). Comparative study of different clinical samples used for the diagnosis of staphylococcal systemic infections in appearent healthy students. *International Journal of Research Publications* 49(1): 1 – 10

Ike, V. E., Iheukwumere, I. H., Iheukwumere, C. M., Dim, C. N., Ezendianefo, J. N., Egbe, P. A., Oragwu, I. P., Orji, C. C., Ogbonnaya, O. C., Onwuasoanya, U. F., Okereke, F. O., & Ochibulu, S. C. (2025a). Prevalence of Bacillus cereus in Powdered Soybean Sold in Uli Community, Anambra State: A Cross-Sectional Study. *IPS Journal of Basic and Clinical Medicine*, *2*(3), 108–114. https://doi.org/10.54117/ijbcm.v2i3.18

Ike, V. E., Iheukwumere, I. H., Iheukwumere, C. M., Dim, C. N., Ezendianefo, J. N., Egbe, P. A., Oragwu, I. P., Orji, C. C., Ogbonnaya, O. C., Onwuasoanya, U. F., Okereke, F. O., & Ochibulu, S. C. (2025b). *Bacillus cereus in Uli's cornflour: A prevalence study*. *IPS Journal of Nutrition and Food Science*, *4*(3), 544–548. https://doi.org/10.54117/8btte840

Ike, V. E., Iheukwumere, I. H., Iheukwumere, C. M., Dim, C. N., Ezendianefo, J. N., Egbe, P. A., Oragwu, I. P., Orji, C. C., Ogbonnaya, O. C., Onwuasoanya, U. F., Okereke, F. O., & Ochibulu, S. C. (2025c). Pathogenic Profile Analysis: In Vitro Screening of Enteric Bacteria from University Dusters. *IPS Journal of Applied Microbiology and Biotechnology*, *4*(3), 187–191. https://doi.org/10.54117/ijamb.v4i3.76

Ike, V. E., Iheukwumere, I. H., Iheukwumere, C. M., Dim, C. N., Ezendianefo, J. N., Egbe, P. A., Oragwu, I. P., Orji, C. C., Ogbonnaya, O. C., Onwuasoanya, U. F., Okereke, F. O., & Ochibulu, S. C. (2025d). Frozen Fish Pathogens: Antimicrobial Resistance and Public Health Implications. *IPS Interdisciplinary Journal of Biological Sciences*, *4*(4), 138–143. https://doi.org/10.54117/iijbs.v4i4.77

Ike, V. E., Iheukwumere, I. H., Iheukwumere, C. M., Dim, C. N., Ezendianefo, J. N., Egbe, P. A., Oragwu, I. P., Orji, C. C., Ogbonnaya, O. C., Onwuasoanya, U. F., Okereke, F. O., & Ochibulu, S. C. (2025e). Stream water quality assessment: Antibiotic resistance of Lac-positive enteric bacterial isolates. *Journal of Pollution Monitoring, Evaluation*

Studies and Control, *4*(2), 120–125. https://doi.org/10.54117/jpmesc.v4i2.21.2025
Jazi, V., Boldaji, F., Dastar, B., Ashayerizadeh, A., & Rezaie, M. (2017). Effect of fermented soybean meal on growth performance, gastrointestinal morphology, and immune response in broiler chickens. *Animal Feed Science and Technology, 234*, 177–184.
Karthikeyan, R., Balaji, S., and Rajendran, R. (2019). Microbial keratinases and their prospective applications: An overview. *Applied Microbiology and Biotechnology*, 103(15), 6015–6036. https://doi.org/10.1007/s00253-019-09956-4
Ke, K., Sun, Y., He, T., Liu, W., Wen, Y., Liu, S., ... & Gao, X. (2024). Effects of feather hydrolysates generated by probiotic Bacillus licheniformis WHU on gut microbiota of broiler and common carp. *Journal of Microbiology*, *62*(6), 473-487.
Kim, J., Lee, H., & Kim, Y. (2018). Effects of fermented milk products on cholesterol and blood pressure: A review of clinical trials. *Journal of Dairy Science*, *101*(4), 2724–2741. https://doi.org/10.3168/jds.2017-13708
Kim, S. K., Kim, T. H., Lee, S. K., Chang, K. H., Cho, S. J., Lee, K. W., & An, B. K. (2016). The Use of Fermented Soybean Meals during Early Phase Affects Subsequent Growth and Physiological Response in Broiler Chicks. *Asian-Australasian Journal of Animal Sciences*, *29*(9), 1287. https://doi.org/10.5713/ajas.15.0653
Le Doare, K., Holder, B., Bassett, A., & Pannaraj, P. S. (2020). Mother's milk: A purposeful contribution to the development of the infant microbiota and immunity. *Frontiers in Immunology, 11*, 362. https://doi.org/10.3389/fimmu.2020.00362
Li, Y., Guo, B., Wu, Z., Wang, W., Li, C., Liu, G., & Cai, H. (2020). Effects of Fermented Soybean Meal Supplementation on the Growth Performance and Cecal Microbiota Community of Broiler Chickens. *Animals*, *10*(6), 1098. https://doi.org/10.3390/ani10061098
Lv, W., Ma, Y., Zhang, Y., Wang, T., Huang, J., He, S., Du, H., & Guo, S. (2023). Effects of Lactobacillus plantarum fermented Shenling Baizhu San on gut microbiota, antioxidant capacity, and intestinal barrier function of yellow-plumed broilers. *Frontiers in Veterinary Science*, *10*, 1103023. https://doi.org/10.3389/fvets.2023.1103023
Manasseh, C.O., Logan, C.S.P., Ikeyi, A.P., Ede, K.K., Iheukwumere, I.H., Iheukwumere, C.M. and Ejike, C.E. (2025). Investigating the Effects of the Covid-19 Pandemic and Climate Risks on Trade Balance in Emerging Markets. *The Nigerian Health Journal* 25(2): 1-27. https://doi.org/10.71637/tnhj.v25i2.914
Marco, M. L., Sanders, M. E., Gänzle, M., Arrieta, M. C., Cotter, P. D., De Vuyst, L., ... & Hutkins, R. (2021). The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on fermented foods. *Nature Reviews Gastroenterology and Hepatology, 18*(3), 196–208. https://doi.org/10.1038/s41575-020-00390-5
Melini, F., Melini, V., Luziatelli, F., Ficca, A. G., & Ruzzi, M. (2019). Health-promoting components in fermented foods: An up-to-date systematic review. *Nutrients, 11*(5), 1189. https://doi.org/10.3390/nu11051189
Mensah, J. K. M., Adewumi, O. O., & Ogunbanwo, S. T. (2020). Solid-state fermentation of yam peels for nutritional improvement using *Lactobacillus* species. *Journal of Food Science and Technology, 57*(8), 3009–3018.
Meyer, B., Bessei, W., Vahjen, W., Zentek, J., & Harlander-Matauschek, A. (2012). Dietary inclusion of feathers affects intestinal microbiota and microbial metabolites in growing Leghorn-type chickens. *Poultry Science*, *91*(7), 1506-1513. https://doi.org/10.3382/ps.2011-01786
Nwike, M.I., Iheukwumere, I.H. and Uneze, B.C. (2017). Effect of Spices, pH and Temperature on the Survival and Multiplication of Staphylococcus aureus in Locally Made Soya Milk Drink. *Journal of Natural Sciences Research* 7(4).
Obianom, A.O. , Iheukwumere, I.H. , Iheukwumere, C.M. , Ochibulu, S.C., Nnadozie, H. C. and Ifenetu, F. C. (2024). Supersizing the inhibitory activity of Xylopia aethiopica extract against Vibrio cholerae using doxycycline. *Tropical Journal of Applied Natural Sciences* 2(2).
Obiefuna, U. G., Umeh, S. O., & Iheukwumere, I. H. (2025a). Assessing the Impact of Glycemic Index on Microbial Quality and Storage Stability of Tomato Jam. *IPS Journal of Applied Microbiology and Biotechnology*, *4*(3), 192–202. https://doi.org/10.54117/ijamb.v4i3.81
Obiefuna, U. G., Umeh, S. O., & Iheukwumere, I. H. (2025b). Physicochemical and nutritional properties of tomato jam: Influence of sweetener type and glycemic index. *IPS Journal of Nutrition and Food Science*, *4*(3), 561–568. https://doi.org/10.54117/yazv0114
Obiefuna, U. G., Umeh, S. O., & Iheukwumere, I. H. (2025c). Micronutrient profile and acceptability of tomato jam: A comparison of high and low glycemic carbohydrate index sweeteners. *IPS Applied Journal of Nutrition, Food and Metabolism Science*, *3*(2), 67–74. https://doi.org/10.54117/pr4r6c73
Okeke, C. E. Iheukwumere, I. H. Ejike, C.E. (2017). Pathogenicity Study of Dematiaceous Fungi Isolated from Chicken Feeds on Immunoincompetent Chickens. *J. Biol. Agriculture. Healthcare* 7(4).
Omar, A. E., S., H., Ismail, T. A., M., R., M., S. A., Shalaby, S. I., & Ibrahim, D. (2021). Performance, Serum Biochemical and Immunological Parameters, and Digestive Enzyme and Intestinal Barrier-Related Gene Expression of Broiler Chickens Fed Fermented Fava Bean By-Products as a Substitute for Conventional Feed. *Frontiers in Veterinary Science*, *8*, 696841. https://doi.org/10.3389/fvets.2021.696841
Onunkwo, D. N., & Ekine, O. A. (2020). Performance of broiler chickens fed diet containing fermented maize milling waste. *Nigerian Journal of Animal Production*, *47*(1), 214–220.
Ouwehand, A. C., Forssten, S. D., Hibberd, A. A., & Tiihonen, K. (2022). Probiotic and other functional microbes: From foods to health applications. *Current Opinion in Biotechnology, 73*, 237-242. https://doi.org/10.1016/j.copbio.2021.07.001
Park, K. Y., Jeong, J. K., Lee, Y. E., & Daily, J. W. (2021). Health benefits of kimchi (Korean fermented vegetables) as a probiotic food. *Journal of Medicinal Food, 27*(3), 365–375. https://doi.org/10.1089/jmf.2020.0155
Patel, R. M., Shah, N. P., and Prajapati, J. B. (2018). Impact of probiotics on cholesterol metabolism: A review. *Critical Reviews in Food Science and Nutrition*, 58(14), 2496–2514. https://doi.org/10.1080/10408398.2017.1322553
Premathilaka, K. T., Nawarathne, S. R., Nambapana, M. N., Macelline, S. P., Wickramasuriya, S. S., Ang, L., Jayasena, D. D., & Heo, J. M. (2020). Partial or complete replacement of fishmeal with fermented soybean meal on growth performance, fecal composition, and meat quality in broilers. *Journal of Animal Science and Technology*, *62*(6), 824. https://doi.org/10.5187/jast.2020.62.6.824
Safari, H., & Mohit, A. (2024). Feather meal processing methods impact the production parameters, blood biochemical indices, gut function, and hepatic enzyme activity in broilers. *Journal of Animal Science*, *102*. https://doi.org/10.1093/jas/skae068
Safari, H., Mohit, A., & Mohiti-Asli, M. (2024). Fermented feather meal improves the antioxidant status, meat quality, and immune response of broilers. *Iran J Vet Med*, 1-43.
Safari, H., Mohit, A., & Mohiti-Asli, M. (2024). In vitro and in vivo evaluation of the nutritional value of various hydrolyzed feather meals and comparison of their effect on performance and carcass characteristics of broilers. *Heliyon*, *10*(21).
Salehizadeh, M., Ebrahimi, M. T., Mousavi, S. N., Sepahi, A. A., & Orooji, R. (2025). Transforming Feather Meal Into a High-Performance Feed for Broilers. *Veterinary Medicine and Science*, *11*(1), e70199. https://doi.org/10.1002/vms3.70199
Savaiano, D. A., & Hutkins, R. W. (2020). Yogurt, cultured fermented milk, and health: A review. *Nutrients, 12*(5), 1256. https://doi.org/10.3390/nu12051256
Soumeh, E., Mohebodini, H., Toghyani, M., Shabani, A., Ashayerizadeh, A., & Jazi, V. (2019). Synergistic effects of fermented soybean meal and mannan-oligosaccharide on growth performance, digestive functions, and hepatic gene expression in broiler chickens. *Poultry Science*, *98*(12), 6797-6807. https://doi.org/10.3382/ps/pez409
Stanton, C., Ross, R. P., Fitzgerald, G. F., & van Sinderen, D. (2021). Fermented functional foods: Trends and challenges. *Current Opinion in Food Science, 40*, 114–122. https://doi.org/10.1016/j.cofs.2021.02.005
Sugiharto, S. (2016). Role of nutraceuticals in gut health and growth performance of poultry. *Journal of the Saudi Society of Agricultural Sciences*, 15(2), 99–111. https://doi.org/10.1016/j.jssas.2014.06.001
Tesfaye, T., Sithole, B., Ramjugernath, D., and Chunilall, V. (2017). Valorisation of chicken feathers: Characterisation of physical

properties and morphological structure. *Journal of Cleaner Production*, 149, 349–365. https://doi.org/10.1016/j.jclepro.2017.02.083

Ugwu, C. H., Iheukwumere, I. H., Iheukwumere, C. M., Ike, V. E., Dim, C. N., Ezendianefo, J. N., Egbe, P. A., Oragwu, I. P., Orji, C. C., Ogbonnaya, O. C., Onwuasoanya, U. F., Okereke, F. O., Oduenyi, P. M., & Ochibulu, S. C. (2025a). Maternal health and antibiotic resistance: *Klebsiella pneumoniae* isolates analysis. *IPS Journal of Public Health, 5*(3), 290–295. https://doi.org/10.54117/s3tx6v26

Ugwu, C. H., Iheukwumere, I. H., Iheukwumere, C. M., Ike, V. E., Dim, C. N., Ezendianefo, J. N., Egbe, P. A., Oragwu, I. P., Orji, C. C., Ogbonnaya, O. C., Onwuasoanya, U. F., Okereke, F. O., Oduenyi, P. M., & Ochibulu, S. C. (2025b). Ocimum gratissimum Extract's Effectiveness against Vibrio cholerae from Uli Streams. *IPS Journal of Phytochemistry and Medicinal Plant Research*, *1*(2), 15–19. https://doi.org/10.54117/ijpmpr.v1i2.38

Wang, J., Yao, L., Su, J., Fan, R., Zheng, J., & Han, Y. (2023). Effects of Lactobacillus plantarum and its fermentation products on growth performance, immune function, intestinal pH, and cecal microorganisms of Lingnan yellow chicken. *Poultry Science*, *102*(6), 102610. https://doi.org/10.1016/j.psj.2023.102610

Wastyk, H. C., Fragiadakis, G. K., Perelman, D., Dahan, D., Merrill, B. D., Yu, F. B., ... & Sonnenburg, J. L. (2021). Gut-microbiota-targeted diets modulate human immune status. *Cell*, *184*(16), 4137–4153.e14. https://doi.org/10.1016/j.cell.2021.06.019

Xiao, C., Li, X., Ding, Z., Zhang, H., Lv, W., Yang, C., He, D., & Zhu, L. (2023). Enhancing Growth and Gut Health in Squabs: The Impact of Fermented Mixed Feed. *Animals*, *14*(10), 1411. https://doi.org/10.3390/ani14101411

Yan, L., An, S., Lv, X., Lv, Z., Zhang, B., Choct, M., Guo, Y., Wang, Z., Yan, B., & Li, Y. (2025). Effects of replacing soybean meal with cottonseed meal on growth performance, carcass trait, intestinal development and intestinal microbiota of broiler chickens. *Poultry Science*, *104*(2), 104653. https://doi.org/10.1016/j.psj.2024.104653

Yang, R., Khalid, A., Khalid, F., Ye, M., Li, Y., Zhan, K., Li, Y., Liu, W., & Wang, Z. (2022). Effect of fermented corn by-products on production performance, blood biochemistry, and egg quality indices of laying hens. *Journal of Animal Science*, *100*(5). https://doi.org/10.1093/jas/skac130

Yeh, R., Hsieh, C., & Chen, K. (2023). Two-Stage Fermented Feather Meal Enhances Growth Performance and Amino Acid Digestibility in Broilers. *Fermentation*, *9*(2), 128. https://doi.org/10.3390/fermentation9020128

Yu, L., Zhihui, C., Hongzhi, W., Fengjie, J., Yang, L., Jianing, L., ... & Liangmei, X. (2024). Effects of Fermented Puffed Feather Meal on Growth Performance, Serum Biochemical Indices, Meat Quality, and Intestinal Microbiota in Broilers. *Journal of Northeast Agricultural University*, *31*(3).

Zhang, Y., Liu, Y., Lv, L., & Wang, J. (2021). Probiotics in the prevention and treatment of colorectal cancer. *Frontiers in Immunology*, *12*, 714947. https://doi.org/10.3389/fimmu.2021.714947

Zhao, L., Zhang, F., Ding, X., Wu, G., Lam, Y. Y., Wang, X., ... and Zhang, C. (2022). Gut bacteria selectively promoted by dietary fibers alleviate type 2 diabetes. *Science*, *359*(6380), 1151-1156. https://doi.org/10.1126/science.aao5774

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