

# Proximate Evaluation of Fermented Durian Seeds (*Durio zibethinus* Murr.) Using RABAL Probiotic: Potential for Improving Nutritional Quality for Alternative Poultry Feed

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## ABSTRACT

The prevalent dependence on conventional feedstuffs, marked by high price volatility and fluctuating supply, necessitates an intensive search for alternative materials. Durian seed (*Durio zibethinus* Merr.), an abundant agro-industrial waste, offers significant carbohydrate energy potential. However, its nutritional profile is inadequate, characterized by low Crude Protein concentration and high, refractory Crude Fiber content, which severely limits its digestibility and inclusion in poultry rations. This study aimed to evaluate the efficacy of fermentation as a bioconversion strategy by testing and comparing the changes in the chemical composition (proximate analysis) of durian seeds following treatment with a multi-strain inoculum of RABAL Probiotics (Yeast and Lactic Acid Bacteria). A comparative descriptive method was employed, comparing unfermented raw durian seeds (P0) with substrates fermented with RABAL Probiotics for 72 hours (P1). The nutritional components including Moisture Content, Ash Content, Crude Protein, Crude Fat, Crude Fiber and Nitrogen-Free Extract /carbohydrates. Analytical results confirmed successful substrate bio-transformation.

Fermentation induced a substantial 78.95% increase in Crude Protein (from 4.56% to 8.16%) and an efficient 26.50% degradation of Crude Fiber (from 20.19% to 14.84%). In conclusion, fermentation using RABAL Probiotics is an effective biotechnology strategy for remediating anti-nutritional constraints and enhancing nutritional value. This improved profile establishes fermented durian seeds as a viable, economical, and environmentally sustainable functional feed component for poultry livestock.

**Keywords:** [Durian Seed, Fermentation, RABAL Probiotics, Proximate Analysis, Alternative Poultry Feed.]

## INTRODUCTION

Durian seed waste (*Durio zibethinus* Murr.) produced massively in Indonesia presents significant potential as an economical alternative poultry feed raw material, supported by its high functional carbohydrate content. However, its direct utilization is hindered by two main constraints that degrade nutritional value: the high concentration of crude fiber (including cellulose and hemicellulose) limiting digestibility in poultry, and the presence of antinutritional compounds such as tannins and trypsin inhibitors. These

antinutritional compounds pharmacologically reduce feed palatability and inhibit digestive enzyme activity, cumulatively lowering nutrient utilization efficiency and livestock growth performance. Therefore, processing durian seeds into feed is necessary to enhance their nutritional value and reduce antinutritional factors that inhibit nutrient absorption.<sup>[1]</sup>

Standardized physical, chemical, or bioprocessing treatments are required to degrade fiber components and deactivate antinutritional factors, allowing durian seeds to be effectively integrated into poultry ration formulations.

Biological fermentation technology offers an effective and cost-efficient solution to address these challenges. Fermentation using specific microorganisms can degrade complex macromolecules into simpler components. Fermentation has been proven an effective technology to improve the nutritional quality of feedstuffs from organic waste such as durian seeds. Fermentation microorganisms can increase crude protein content and essential amino acids while enhancing feed digestibility, thereby improving poultry performance when included in the ration.<sup>[2]</sup> The use of probiotics in the fermentation process provides additional health benefits and enhances the activity of beneficial microbes in the poultry digestive tract.

The RABAL probiotic (Ragi dan Bakteri Asam Laktat) as a fermentation agent is one probiotic product used to improve digestion and nutrient absorption in chickens by modulating gut microbiota. This probiotic type is known to have a synergistic capability: Lactic Acid Bacteria (LAB) create an acidic environment that inhibits pathogen growth and potentially reduces antinutritional compounds, while yeast (*Saccharomyces* sp.) actively participates in fiber degradation and microbial protein biomass synthesis. By using the RABAL probiotic in durian seed fermentation, it is expected to increase the nutritional content and quality of durian seed flour as an

economical and sustainable alternative poultry feed ingredient.<sup>[3]</sup>

This study aims to evaluate the effectiveness of durian seed fermentation using the RABAL probiotic as an effort to improve the nutritional quality of poultry feed raw materials. Proximate analysis (moisture content, ash, crude protein, crude fat, crude fiber, and nitrogen-free extract/carbohydrates) will be conducted to quantitatively characterize the changes occurring. The evaluation results will provide crucial scientific data regarding the potential nutritional quality improvement of fermented durian seeds, while strengthening the feasibility argument of durian seeds as an environmentally friendly and economical alternative poultry feed, ultimately contributing to the stability and sustainability of the national feed industry.

## **MATERIALS & METHODS**

This research was conducted at two main locations: the first location is in Sibolangit Village, Sibolangit District, Deli Serdang Regency, North Sumatra Province, Indonesia, during July 2025. This location will serve as the source of materials, material preparation, and fermentation. The second location will be the Research Laboratory of the Faculty of Agriculture, Universitas Sumatera Utara, for laboratory analysis (Proximate Analysis).

The research materials consist of: Fresh Durian Seeds (*Durio zibethinus* Murr.), RABAL Probiotic (Yeast and Lactic Acid Bacteria) starter made from coconut water, Yakult, tape yeast (fermented cassava yeast), and palm sugar. Standard chemical reagents required for proximate analysis according to the<sup>[4]</sup> method, including: concentrated sulfuric acid (H<sub>2</sub>SO<sub>4</sub>), sodium hydroxide (NaOH), potassium sulfate (K<sub>2</sub>SO<sub>4</sub>), catalyst, and other solvents.

The equipment used includes: Cutting/slicing tools, drying oven, digital scale, grinder (flour mill), airtight fermentation container, pH meter, and standard equipment for Proximate Analysis

(Kjeldahl set, Soxhlet set, Muffle Furnace, Oven, Desiccator, Analytical Balance).

This study employs a Descriptive Comparative design to compare the nutritional composition before and after treatment. The main treatments tested are:

- P0 (Control) : Unfermented Durian Seeds.
- P1 (Treatment): Durian Seeds Fermented Using the RABAL Probiotic.

### Preparing the RABAL Probiotic Starter

Tape yeast, Yakult, coconut water, and palm sugar are prepared. 100-15 grams of palm sugar are dissolved into 1 liter of coconut water. 1-2 teaspoons of tape yeast are added to the solution and stirred well. 1-2 bottles of Yakult are poured into the mixture and stirred again until all ingredients are well combined. The mixture is stored in an airtight container for 3-7 days of fermentation.

### Fermenting Durian Seeds with RABAL Probiotic

Clean the durian seeds → Soak the durian seeds for 24 hours → Peel the thin seed coat (testa) → Steam the durian seeds until tender → Cool the durian seeds → Mix the RABAL starter with the cooled durian seeds → Put the inoculated durian seeds into a plastic bag → Seal the plastic bag tightly → Let stand for a period of time (fermentation period) → Dry the fermented durian seeds under sunlight → The fermented durian seeds are then ready for application.

### Sampling

All treatments will be repeated three times (triplicate) to ensure the validity of the laboratory data. Samples will be randomly taken from treatment P0 (control) and P1 (RABAL fermentation) from each replicate (triplicate). Each sample will be packaged, labeled with a code, and sent to the laboratory for testing.

### Parameters Measured (Proximate Analysis)

The parameters measured for each sample (P0 and P1) include Proximate Analysis based on the [4] method:

- Moisture Content : Oven drying method at 105<sup>0</sup>C.
- Ash Content: Incineration method in a muffle furnace at 550<sup>0</sup>C.
- Crude Protein: Kjeldahl method (measuring Nitrogen content, then multiplied by a conversion factor of 6.25).
- Crude Fat: Extraction method using the Soxhlet apparatus.
- Crude Fiber: Sequential acid and base hydrolysis method.
- Nitrogen-Free Extract (NFE)/ carbohydrates: Calculated based on the formula:

$$\text{NFE/carbohydrates} = 100 - (\{\text{Moisture Content}\} + \{\text{Ash Content}\} + \{\text{Crude Protein}\} + \{\text{Crude Fat}\} + \{\text{Crude Fiber}\})\%$$

### STATISTICAL ANALYSIS

The data obtained from the proximate analysis results will be presented in a comparative table of mean ± standard deviation for each treatment replicate (P0 and P1). Data analysis will be conducted using descriptive comparative and qualitative methods to interpret:

1. Magnitude of Change: Measuring the percentage increase or decrease of each nutritional component (Crude Protein, Crude Fiber, Crude Fat, Nitrogen-Free Extract/ carbohydrates) in P1 compared to P0.
2. Nutritional Feasibility: Scientifically describing the implications of these changes on the improved digestibility and the nutritional potential of the feed ingredient for poultry. This interpretation will be supported by current literature studies

### RESULT

The results of the proximate analysis evaluation of unfermented Durian Seed

Flour (DSF) (P0) and DSF fermented with the RABAL Probiotic (P1) are presented in Table 1.

**Table 1. Comparative Proximate Analysis Composition of Unfermented Durian Seeds (P0) and RABAL Probiotic Fermented Durian Seeds (P1) (Dry Matter Basis)**

Nutritional Component	Unfermented Durian Seed (P0) (%)	Fermented Durian Seed (P1) (%)	Change (%)	Description
Moisture Content	12.14±0.15	11.12±0.12	-8.40	Decrease
Ash Content	8.88±0.05	9.15±0.08	+3.04	Increase
Crude Protein (CP)	4.56±0.21	8.16±0.45	+78.95	Significant Increase
Crude Fat (CFa)	04.03±0.04	2.97±0.03	-26.30	Decrease
Crude Fiber (CF)	20.19±0.70	14.84±0.40	-26.50	Decrease
Nitrogen-Free Extract (NFE)	71.50±0.80	74.42±0.95	+4.08	Increase (as Carbohydrates)

Note: The table above presents data on a dry matter basis (except for moisture content).

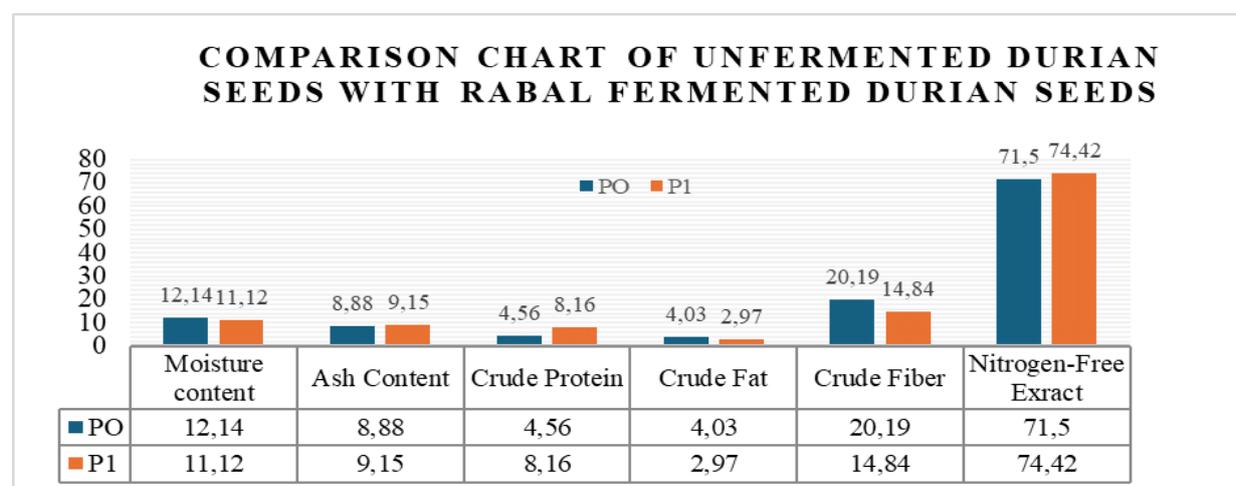


Figure 1. Comparison chart of unfermented durian seeds with RABAL fermented durian Seeds

## DISCUSSION

### Increase in Crude Protein (CP)

The analysis results in Table 1 show a very substantial increase in Crude Protein content in the P1 treatment (RABAL Fermentation) by 78.95% (from 4.56% to 8.16%) compared to P0. This drastic increase is an indication of the success of applying fermentation technology using the RABAL Probiotic.

The increase in Crude Protein is primarily attributed to the synthesis of Single Cell Protein (SCP) by the microbial biomass (Yeast and Lactic Acid Bacteria) during the fermentation process.<sup>[5]</sup> RABAL microbes utilize the carbohydrate rich substrate from durian seeds as an energy source for growth and reproduction. These growing microbial cells are rich in protein, and when the biomass is analyzed, there is an increase in the total Crude Protein content of the feed

ingredient. Similar effects have been found in the fermentation of other seed wastes, where microorganisms convert non-protein components into protein components.<sup>[6]</sup> The Crude Protein value of 8.16% makes the fermented durian seeds equivalent to some medium-protein feed sources, and highly viable for partial substitution of conventional feed in poultry rations.

### Reduction in Crude Fiber (CF)

The Crude Fiber content showed a significant decrease of 26.50% in the P1 treatment (from 20.19% to 14.84%). This reduction is a positive indication for the potential of poultry feed, considering that the high Crude Fiber in unfermented durian seeds (20.19%) is a primary limiting factor in its utilization.<sup>[7]</sup>

The decrease in Crude Fiber is confirmed to be due to the activity of cellulolytic and

hemicellulolytic enzymes produced by the microorganisms in the RABAL Probiotic, especially the yeast.<sup>[8]</sup> These enzymes break down complex fiber components (cellulose and hemicellulose) into simple sugars, which are subsequently used by the microbes for growth or converted into organic acids. Qualitatively, the reduction in Crude Fiber directly means an increase in the digestibility and metabolizable energy value of the feed for poultry, as poultry have limitations in digesting high fiber.

### Changes in Other Components (Carbohydrates, Ash, Fat)

- **Nitrogen-Free Extract (NFE)/Carbohydrates:** An increase in carbohydrates (indicating digestible carbohydrates) from 71.50% to 74.42% (+ 4.08%) occurred despite the carbohydrate substrate being used for microbial protein synthesis. This increase is likely due to the breakdown of crude fiber into simpler carbohydrate components (sugars) which are accounted for in the NFE fraction. Although most of these sugars are utilized by the microbes, the fiber degradation process is more dominant in increasing this fraction.
- **Ash Content:** A slight increase in Ash Content (+3.04%) suggests that fermentation may increase the relative mineral concentration due to the breakdown and reduction of the organic fraction, or due to the mineral content within the RABAL culture it self.<sup>[9]</sup>
- **Crude Fat:** The decrease in Crude Fat (26.30%) may be caused by the utilization of endogenous fat or lipids by the microbes as an alternative energy source during the fermentation process, or due to minor fat oxidation that occurs.

### Potential for Improved Nutritional Quality for Poultry Feed

The proximate evaluation results consistently describe an improvement in the nutritional quality of durian seeds through RABAL fermentation. Durian seeds,

initially classified as waste with very low protein and high fiber (Crude Protein 4.56%, Crude Fiber 20.19%), are transformed into a feed ingredient with:

- Higher Crude Protein Content (8.16%), making it a potential partial alternative protein source.
- Lower Crude Fiber Content (14.84%), which increases potential digestibility and minimizes negative impacts on the poultry gut.<sup>[10]</sup>

Based on the literature, the RABAL Probiotic is also effective in inhibiting the growth of pathogenic bacteria and reducing antinutritional compounds through pH reduction.<sup>[11]</sup> Thus, durian seeds fermented with the RABAL probiotic are highly viable to be considered as an alternative poultry feed ingredient that not only utilizes waste but also provides a more balanced nutritional profile and has the potential to improve livestock performance.

### CONCLUSION

Based on the proximate analysis evaluation and discussion, the following can be concluded:

1. The application of fermentation using the RABAL Probiotic is proven effective in modifying the nutritional composition of durian seeds (*Durio zibethinus* Murr.). The fermentation treatment (P1) successfully demonstrated a significant improvement in nutritional quality compared to unfermented durian seeds (P0).
2. The main nutritional quality improvement is marked by an Increase in Crude Protein by almost 80% (from 4.56% to 8.16%), and a Substantial Reduction in Crude Fiber of 26.50% (from 20.19% to 14.84%), which indicates an increase in digestibility and potential metabolic energy of the feed.
3. Overall, Durian Seed Flour fermented with the RABAL Probiotic has very high potential and is viable for further development as a more nutritious, economical, and sustainable alternative feed ingredient for poultry.

### Declaration by Authors

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