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RESEARCH ARTICLE

USE OF CASTOR OIL CAKE AND CASTOR OIL IN IMPROVING THE NUTRITIONAL CHARACTERISTICS AND PEROXIDASE ACTIVITY OF EGGPLANT (Solanum melongena L.)

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ABSTRACT

Polyphenol oxidases (PPOs) are enzymes involved in the oxidation of polyphenols into quinones under the action of molecular oxygen, causing certain vegetables to brown. They also participate in essential biological processes such as cellular respiration, photosynthesis, and plant defense systems. Faced with agricultural challenges, including the proliferation of pests, the harmful effects of chemical inputs on the production chain, and the short shelf life of eggplants, the search for sustainable solutions is intensifying. This study aims to evaluate the impact of combining castor meal and castor oil on improving the nutritional and enzymatic properties of eggplants. The experiment was conducted using a randomized block design (4x4), with four treatments: a negative control, the application of cake (1.9 t/ha), castor oil (5 l/ha), and a combination of the two (0.95 t/ha + 2.5 l/ha). Analysis of the results reveals that the fiber content of the fruit reached 7.45% for the control, followed by 7.02% for castor oil, and 6.68% and 6.85% for oil alone and the meal-oil combination, respectively. In terms of protein, castor meal achieved 21.26%, compared to 17.55% for castor oil, while the meal-oil mixture and the negative control showed 13.30% and 0.18% respectively. In terms of enzyme activity, castor oil induced peroxidase of 15.18 IU, while the other treatments showed values of 11.95 IU (control), 10.96 IU (cake-oil) and 10.15 IU (cake alone). The polyphenol oxidase rate was slightly higher in the control (12.15 IU) and lower with the meal-castor oil combination (11.97 IU). The integration of meal and castor oil into eggplant cultivation is therefore an innovative approach to optimizing the nutritional value of the fruit while enhancing peroxidase activity and reducing polyphenol oxidase activity.

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INTRODUCTION

The application of ecological principles to agriculture, integrating nutrient recycling into agroecosystemsplays a crucial role in protecting and restoring biodiversity (1). The use of biopesticides derived from local resources promotes sustainable soil and water managementandhelps mitigate climate change (2). According to the previous, the use of biofertilizers and biopesticides is a promising approach to transforming global diets and addressing environmental and social issues (3) ;(4) et (5), Castor bean meal is a promising biofertilizer for agro ecological practices. Eggplant is an essential crop in many tropical and subtropical areas, but it currently faces several challenges that limit its production (6), (7). Biochemically, it suffers from the accumulation of phenolic compounds, excessive peroxidase activity, low concentrations of certain nutrients, and the presence of glycoalkaloids. Agronomically, its susceptibility to disease and pest infestation is a major obstacle to improving its productivity and nutritional quality (6), (7). Peroxydases (EC 1.11.1.7) are enzymes that catalyze the oxidation of substrates in the presence of hydrogen peroxide (H2O2). They are involved in certain physiological processes, particularly resistance to biotic and abiotic stress (8). It has been demonstrated that the nutritional value of fresh eggplant is diverse. It contains 14.11% protein, 63.17% total carbohydrates, 24.75% fiber, and 47.84 mg EAG/100 mg of phenols (9). Fresh eggplant consists of 92.7 to 93.3% moisture, 1.4 to 13.31% protein, 1.34% fiber, 0.3 to 2.66% fat, and vitamins (A and C) (10) et (11). The fiber content can vary between 2.7 and 3% of fresh weight(12). Enzymatic browning is a phenomenon that negatively affects the sensory and nutritional properties of

eggplants after harvest(13). Polyphenol oxidase (PPO) catalyzes the oxidation of phenolic compounds, causing eggplant fruit to brown. Peroxidases are responsible for plant resistance to biotic and abiotic stress. The levels of these enzymes can range from 2 to 20 (8), (14). It is important to give here the motivation of this research

MATERIALS AND METHODS

Presentation of study sites: The experiment was conducted at the experimental station of the Department of Agriculture of the Agronomic Institute of Faranah, in the Republic of Guinea (Fig. 1). The climate of the experimental area is characterized by a rainy season from May to October, followed by a cold dry season from November to January, and then a hot dry season from February to March. March has the highest maximum temperature, reaching 38.76°C. December and January are cold, with a minimum temperature of 8°C. During the trial period, total rainfall was 115.7 mm spread over eight days of rain, giving a monthly average of 14.46 mm (15).

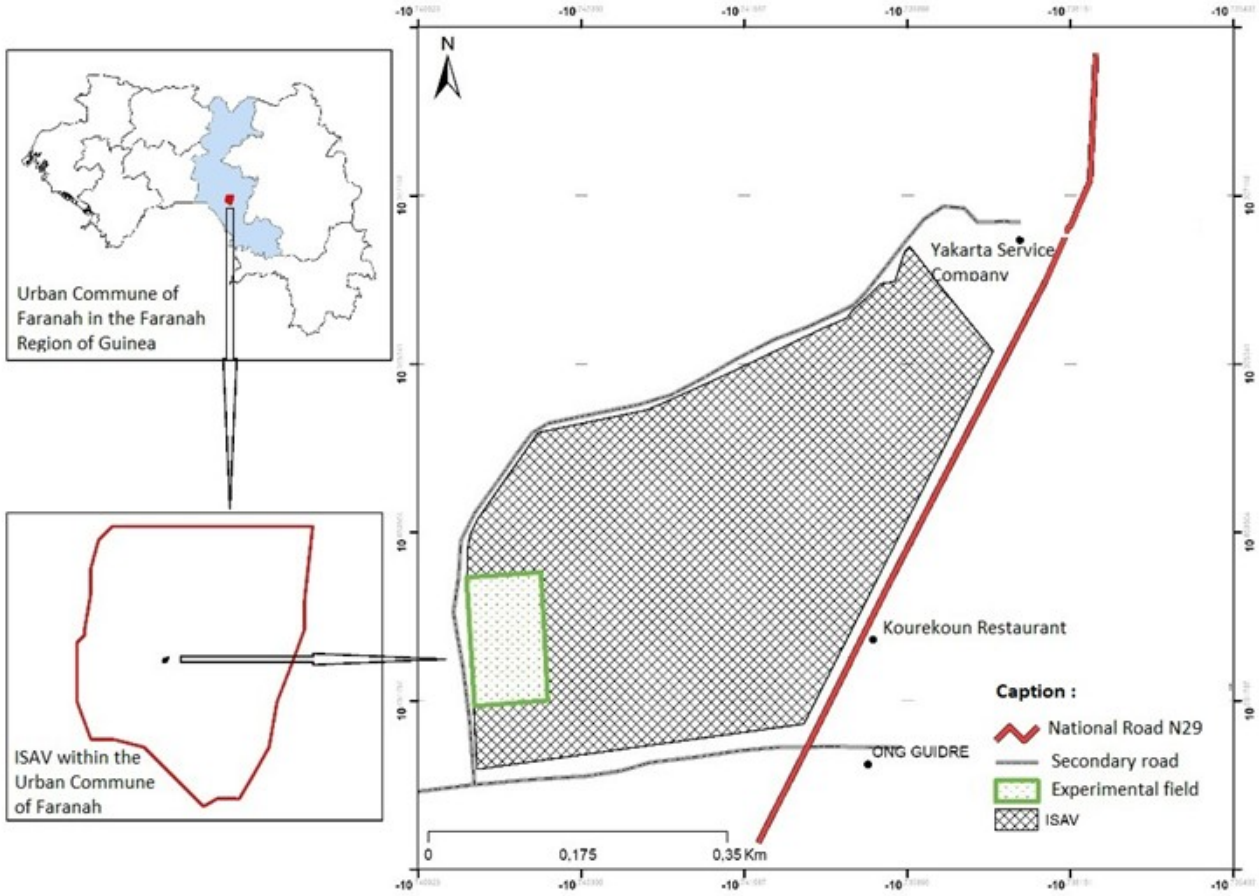

Figure 1. Map of the study area

Presentation of plant material: The eggplant (Solanum melongena) is a vegetable plant belonging to the Solanaceae family, cultivated for its fruit, which is generally purple in color. In order to obtain robust and uniform plants, a 2m x 1m nursery was set up. The quantity of seed sown in the nursery was 5.2g. The nursery lasted 21 days, corresponding to the 2-3 leaf stage of development. Transplanting was done on the 21st day. The planting spacing was 0.6 m between rows and 0.6 m within rows. The Barbentane variety was used as experimental material for the study.

Obtaining castor oil and meal: The castor meal used in this study comes from the urban area of Faranah. The meal was obtained after extracting the oil from the castor seeds using a cold press machineas described (15). It was ground into powder by hand. A total of 12 kg of castor cake was collected. Castor meal is a natural and pure organic fertilizer. It is rich in major nutrients and trace elements, releases nitrogen into the soil very gradually, and ensures better flowering and fruiting.(16), (17). It also provides organic matter and stimulates microbial life in the soil. When used to fertilize soil, it is applied at a rate of 1 to 3 tons per hectare.

Methods

Proximal and enzymatic analyses: Proximal and enzymatic analyses were performed monthly for three weeks. All analyses were performed in triplicate per treatment. The samples used to determine enzyme activity were ground in a porcelain mortar, reduced to small particles, soaked in water, stirred, centrifuged, and then the supernatant was collected before being analyzed by spectrophotometer to determine polyphenol oxidases and peroxidases. The samples used in other studies were dried in an oven to determine moisture content. Some were calcined to determine ash content and others were ground into powder for other studies.

The parameters measured were: moisture content, dry matter, total ash, protein, lipids, total carbohydrates, fiber, energy carbohydrates, energy values, peroxidases, and polyphenol oxidases.

Analytical protocols: Protocols were developed for the parameters listed above. Each protocol is based on recognized and referenced scientific methods. They enable a reliable and reproducible assessment of the content of the various constituents in the samples analyzed.

Protocol for determining moisture content: After initial drying at 105°C for 6 hours, the samples were finely ground. The porcelain or platinum crucibles were cleaned, heated, and weighed before 5 g of sample was added. Incineration took place at 550°C for 6 hours in a muffle furnace. The resulting ashes, which were white or light gray in color, were cooled in a desiccator before a final weighing. The ash content was then calculated using the AOAC formula(2000) (18) :

$$\%\ Humidité = \frac{Pf - Pi}{PE} \times 100$$

% Dry matter = 100 – Moisture

Protocol for determining ash content: After drying at 105°C for 6 hours, the eggplant samples are finely ground. Preheated and weighed crucibles are filled with 5 g of sample before incineration at 550°C for 6 hours. The resulting ash is cooled and weighed to calculate the ash content according to the AOAC formula(2000) (18).

$$\%\ Ash = \frac{M3 - M1}{M2 - M1} \times 100$$

Protocol for measuring peroxidase activity: The samples are reduced to a paste and mixed with a saline solution. After resting at 4°C and centrifugation, the supernatant containing the enzyme extract is recovered. Enzyme activity is measured via a reaction involving guaiacol and hydrogen peroxide, producing a colored compound whose absorbance is read at 470 nm. Enzyme activity A is expressed in IU (µmol/min) and is calculated using the Chance &Maehly formula(1954) (19).

$$A = \frac{V_T.(\Delta DO/\varepsilon.L)}{T}$$

ε = molar extinction coefficient
L = optical path length
VT=total volume
T=enzymatic reaction time

Extraction of polyphenol oxidases: The extraction of polyphenol oxidases (PPO) was carried out according to the previous protocol (20). A homogenized eggplant paste (500 mg) is mixed with 1200 ml of refrigerated phosphate buffer (pH 6.8) containing Triton X-100 and ascorbic acid. The crude extract is then filtered and centrifuged at 4000 rpm for 5 minutes at 4°C. The supernatant obtained is stored at 4°C and used as crude enzyme. PPO activity is measured by the increase in absorbance at 420 nm, with catechol as substrate, after 3 minutes of reaction in phosphate buffer at pH 6.8 at 25°C. The formula below was used to determine the activity of polyphenol oxidases.

$$PPO\ activity\ \left(\frac{U}{mL}\right) = \frac{\Delta A\ \times V_{total}.(\Delta DO/\varepsilon.L)}{\varepsilon \times d \times V_{enzyme}}$$

- ✓ ΔA = change in absorbance per minute (usually at 420 or 410 nm depending on the substrate)
- ✓ V_{total} = total volume of the tank (mL)
- ✓ ε = Molar extinction coefficient of the product formed ($M^{-1}\cdot cm^{-1}$)
- ✓ d = length of the tank (usually 1 cm)
- ✓ V_{enzyme} = volume of enzyme extract used (mL)

Protocol for determining total protein: The protein content of eggplant fruit was determined using the Kjeldahl method. Organic nitrogen is converted into ammonium ions by digestion with concentrated sulfuric acid in the presence of catalysts. After drying the fruit at 45°C for 24 hours and grinding it into a fine powder, 1 g of powder is mixed with sulfuric acid and a Kjeldahl tablet, then heated to 520°C for two hours. The cooled mixture is then distilled with a NaOH solution and directed into an Erlenmeyer flask containing boric acid. Approximately 150 ml of distillate is collected and then titrated with 0.1 N sulfuric acid until a color change occurs(18), (21), (22). The nitrogen and protein content is calculated based on the results obtained using the formula below:

$$\text{Nitrogen content (\%)} = \frac{(\text{Sample V} - \text{V white}) \times \text{N} \times 14{,}007}{\text{Sample weight (mg)}} \times 100$$

$$\text{Protein content (\%)} = F \times 100$$

With V = acid used (ml)
N = acidity normality
F = Protein conversion factor (F = 6,25)

Protocol for determining total carbohydrates: Total carbohydrates were determined using the indirect method of the FAO (2003) (23) illustrated below:

Carbohydrates (%) = 100 – (% Moisture + % Protein + % Lipids + % Ash)

Protocol for determining total lipid or fat content: The lipid content of eggplant fruit was determined using the Soxhlet extraction method formula (24). The lipids are extracted using an organic solvent (hexane) in a semi-continuous hot process, followed by evaporation of the solvent to recover the fats. The protocol consists of weighing 5 g of dried flour and placing it in an extraction cartridge in the Soxhlet. Next, 400 ml of hexane are added to an extraction flask connected to a refrigerator to condense the solvent vapors. After 4 hours of extraction, the solvent is evaporated, and the collected lipids are dried at 103°C for one hour before being weighed. The tests are performed in triplicate, and the lipid content is calculated from the weight variations. The formula below was used to determine the lipid content.

$$\text{Lipid content (\%)} = \frac{(\text{Weight of the balloon with liquid} - \text{Weight of empty balloon})}{\text{Dry weight of the sample (mg)}} \times 100$$

Protocol for determining crude fiber content: The crude fiber content of the eggplant flour samples was determined using the Sluiter et al. (2012) (25) method. Insoluble and soluble lignin were measured. A mass of 0.3 g of flour was hydrolyzed with sulfuric acid (72%) for 2 hours, with periodic stirring. After adding distilled water, a second hydrolysis was carried out in an autoclave at 121°C for 1 hour. The hydrolysate was then filtered, and the insoluble lignin was determined after drying at 105°C and incineration at 575°C. The soluble lignin was measured by spectrophotometry at 320 nm. The crude fiber content was obtained by adding these two fractions together. The crude fiber content was calculated by summing the acid-soluble lignin and the insoluble lignin. The crude fiber content was calculated by summing the acid-soluble lignin and the insoluble lignin.

Insoluble lignin (%) = a-bc×100
Soluble lignin (%) = A110×Dilution×100

a: residue on the filter (g);
b: weight of ash in the residue (g);
c: weight of the sample (g);
A: Absorbance; m: mass of the sample (g)

Statistical analyses: The data were subjected to analyses of variance (ANOVA). XLSTAT version 2016, GraphPad Prism version 7, and Origine Pro 2024 software were used for statistical analyses and graph presentation. Significant differences between means were revealed by Tukey's test ($p < 0.05$).

RESULTS

Moisture, dry matter, and fiber content of eggplant fruit: The assessment of moisture and dry matter is a key indicator of fruit quality. It allows us to estimate their water content, determine their ability to resist deterioration during storage, and ensure the preservation of essential nutrients such as carbohydrates, proteins, fiber, and minerals. These analyses also provide valuable information on the nutritional density of the fruit, thus offering a better assessment of its nutritional value. The analysis in Figure (a) reveals that fruits treated with castor oil have significantly higher moisture content than those treated with castor meal and meal & oil, with a marked statistical difference ($p < 0.01$). Conversely, dry matter is lower for castor oil, while it is higher in the other treatments, particularly Cake & Oil, where the differences are highly significant ($p < 0.001$), thus highlighting an inverse relationship between moisture and dry matter. The fiber content of eggplant fruit (Fig. b) varies depending on the treatment. The Cake & Oil treatment has the lowest average value, while the Castor Oil, Castor Cake, and Negative Control treatments have higher contents, although not all differences are significant. However, a statistical difference is observed between Cake & Oil and Negative Control ($p < 0.05$). In general, castor oil alone significantly increases fruit moisture while reducing dry matter. On the other hand, the Cake & Oil treatment promotes a better distribution of dry matter, but leads to a decrease in fiber content.

Influence of treatments on nutritional parameters according to analysis of variance: Analysis of variance (ANOVA) indicates a highly significant effect of treatments ($p < 0.0001$) on all nutritional parameters examined, with the exception of total ash, which shows no significant variation ($p = 0.361$). The variables affected include moisture, dry matter, protein, lipids, total carbohydrates, energy carbohydrates, and energy value. The highest coefficients of determination (R^2) were recorded for protein (1.000), energy carbohydrates (0.999), and total carbohydrates (0.998), reflecting the high sensitivity of these parameters to the treatments applied. The graph below illustrates the impact of various castor-based treatments (oil, cake, and their combination) on

two nutritional parameters of eggplant: (a) crude fiber content (%) and (b) average energy values (%). In terms of fiber content, the average values range from 7 to 8% depending on the treatment. The mixture of cake and castor oil has the lowest fiber content.

Table 1. Summary of variance analyses

	Humidity (%)	Dry matter (%)	Total Ash (%)	Protein (%)	Lipids (%)	Total carbohydrates (%)	Fiber (%)	Energy carbohydrates (%)	Val Ener (kcal/100g DM)
R^2	0.947	0.947	0.315	1.000	0.945	0.998	0.665	0.999	0.924
F	47.934	47.934	1.228	44483.043	45.616	1500.861	5.287	1894.429	32.218
Pr > F	< 0.01	< 0.01	0.361	< 0.01	< 0.01	< 0.01	0.027	< 0.01	< 0.01

Legend: R^2: coefficient of determination of data variability due to the study factor; F: ratio of factor variance to error variance, and Pr> F: means probability (P).

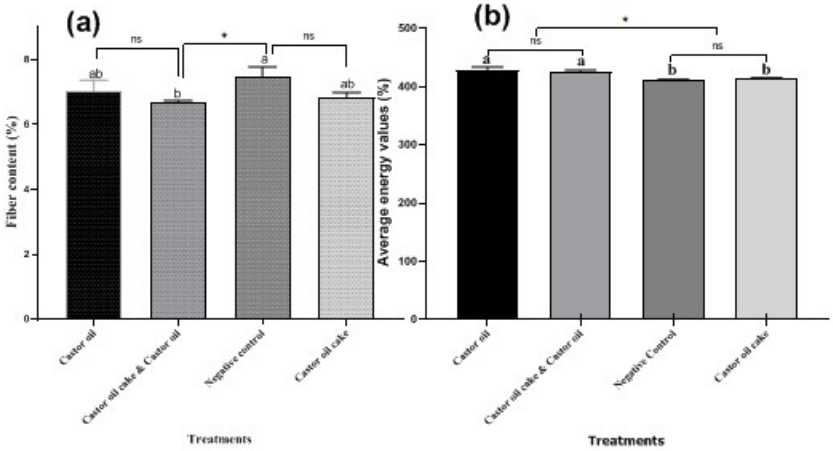

Fig. 2.a: Fiber content of fruits Fig. 2. b: Energy content of fruits

Conversely, the negative control treatment has a significantly higher content compared to the cake & oil treatment ($p < 0.05$). The castor oil and castor meal (ab) treatments show no significant difference compared to the other groups. For energy values, the averages are around 400%, with a general downward trend depending on the treatments applied. Among these, castor oil stands out with the highest energy value.

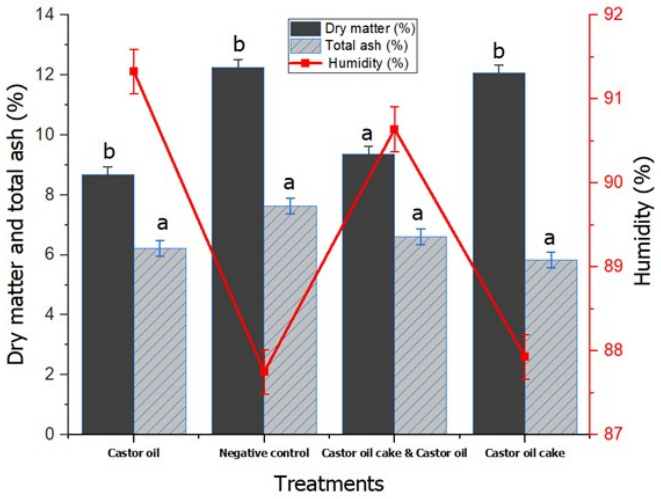

Figure 3. Combined effects of castor oil and castor meal on dry matter, total ash, and moisture content

This graph highlights the impact of different treatments – castor oil, negative control, cake & oil, castor cake – on three physical properties of eggplant: dry matter, total ash, and moisture. With regard to dry matter, the highest levels (12.5%) are observed with the negative control and castor meal, indicated by the letter "b." Conversely, castor oil and the meal & oil combination had significantly lower values (between 8.5% and 9.5%), identified by the letter "a." For total ash, no significant variation between treatments was observed, all being marked "a", with rates fluctuating between 6.2% (castor oil) and 7.8% (negative control). Moisture content varied in the opposite direction to dry matter: it was highest with castor oil (91.5%) and the cake & oil treatment (90.5%), while it was lowest with the negative control (87.5%) and castor cake (88%). Thus, the treatments significantly influence the dry matter and moisture content of eggplant, but not the total ash content. The negative control and castor meal promote the accumulation of dry matter, thereby reducing moisture, while castor oil and the meal & oil combination maintain a higher water content. These results are decisive in guiding the choice of treatments according to the objectives of preserving or processing eggplant. The graph illustrates the effect of castor oil, cake & oil, negative control, and castor cake treatments on protein (%) and lipid (%) levels.

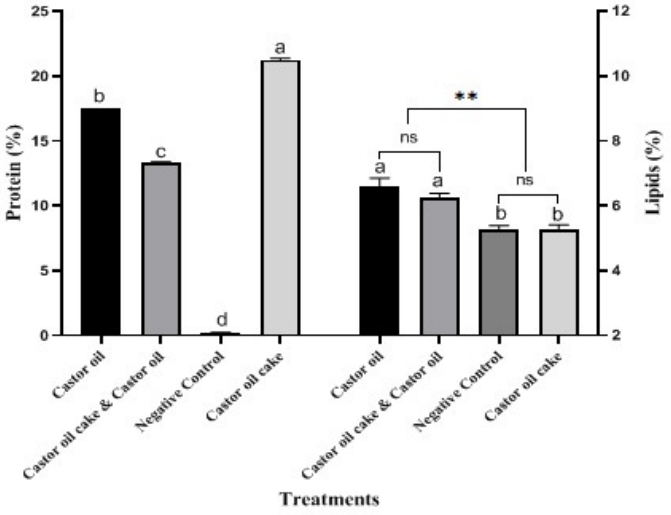

Figure 4: Effects of treatments on protein and lipid content

In terms of protein, the castor meal treatment resulted in the highest content (21%), significantly higher than the other treatments (letter a). Castor oil had a content of 17%, distinct from castor meal and meal & oil (letter b). Similarly, the cake & oil treatment has a content of 13%, which differs from that of castor oil (letter c). Conversely, the negative control shows the lowest content (0.46%), significantly lower than all other treatments (letter d). With regard to lipids, the values vary between 5 and 8%. The castor oil and cake & oil treatments show the highest contents (around 8%), with no significant difference between them (letter a). On the other hand, the negative control and castor cake show the lowest values (5%), which are also similar (letter b). A highly significant difference ($p < 0.01$) is observed between the cake & oil treatment and the negative control. In general, the graph shows that castor meal significantly improves protein content, while castor oil and its mixture with meal significantly increase lipids. The negative control shows the lowest values for both parameters, highlighting the beneficial effects of castor-based inputs on the nutritional quality of eggplant.

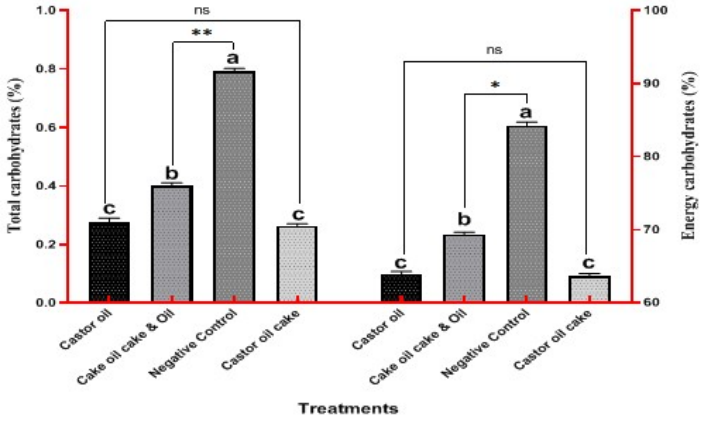

Figure 5. Combined influence of castor oil and castor meal on total carbohydrate concentration (%) and energy carbohydrates (%)

The graph above shows the combined effect of castor oil, oil cake & oil, negative control, and castor oil cake on total carbohydrate content (%) and energy carbohydrate content (%). Regarding total carbohydrates (%), the negative control has the highest concentration (0.8%), significantly higher than the other treatments (letter a). The meal & oil treatment (0.5%) is statistically different from the negative control and has a higher content than castor oil and castor meal (letter b). The castor oil and castor meal treatments show the lowest values (0.3%), which are statistically equivalent (letter c). A highly significant difference ($p < 0.01$) is observed between cake & oil and the negative control, while no difference is observed between the negative control and castor cake. In terms of energy carbohydrates (%), the negative control has the highest value (95%), statistically distinct from the other treatments (letter a). The cake & oil treatment (85%) came in second place, showing a significant difference compared to the control ($p < 0.05$, letter b). The castor oil and castor cake treatments had the lowest values (70%), with no significant difference between them (letter c). Furthermore, no significant difference was observed between the negative control and the castor oil cake. In general, the negative control promotes maximum accumulation of total and energy carbohydrates, which could reflect a metabolic imbalance in the absence of external nutritional input. On the other hand, castor-based treatments, although they reduce carbohydrates, could optimize the distribution to other constituents, such as proteins and lipids, thus contributing to better overall nutritional quality. The graph illustrates the effect of various castor-based treatments on the activity of two antioxidant enzymes: peroxidase (left) and polyphenol oxidase (right), expressed in international units (U/g.MF). With regard to peroxidase activity, castor oil induces significantly higher activity (16 U/g.MF) than the other treatments, with a highly significant difference ($p < 0.01$) compared to the negative control.

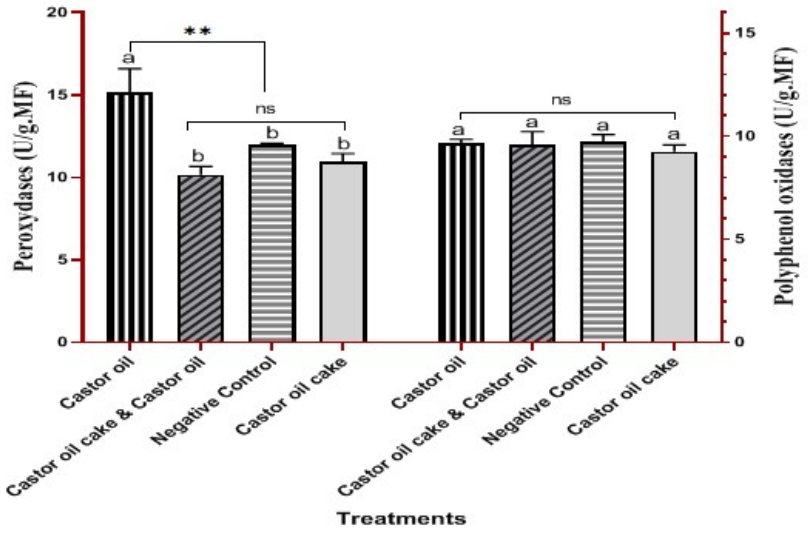

Figure 6. Effect of castor-based treatments on peroxidase and polyphenol oxidase activity

The cake & oil, negative control, and castor cake treatments show similar levels of activity (letter b), while the oil alone stands out significantly (letter a). These results suggest that castor oil plays a key role in antioxidant defense by stimulating peroxidase activity. As for polyphenol oxidase, the four treatments showed comparable values (10 U/g.MF), with no significant difference between them (letter a, marked "ns"). Overall, castor oil appears to be the most effective treatment for increasing peroxidase activity, while none of the treatments tested had a significant impact on polyphenol oxidase activity. Castor oil is an effective natural agent for improving post-harvest quality and stimulating the defense of eggplant plants. The effect is further enhanced when combined with oilcake, which further limits enzymatic browning.

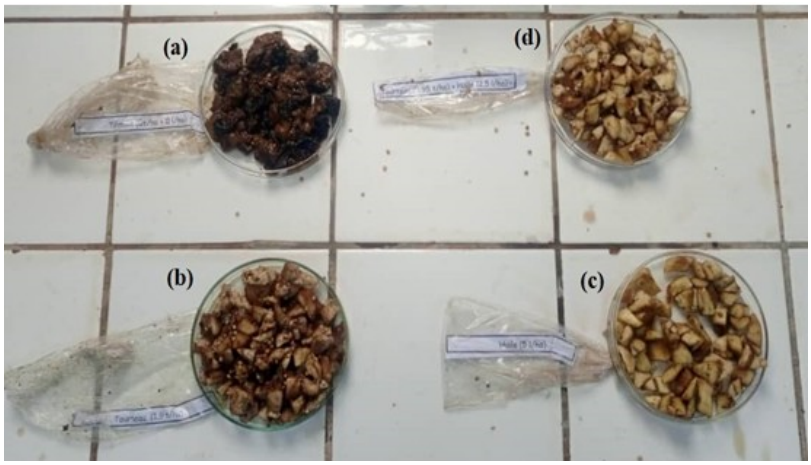

Figure 7. Influence of castor-based treatments on the browning of eggplant fruit

Enzymatic browning of eggplant fruit is triggered by the action of polyphenol oxidase (PPO) and peroxidase (POD) enzymes. This image visually illustrates the impact of different pre-harvest treatments on the intensity of fruit browning. The negative control (a) shows very pronounced black browning, revealing a lack of protection against oxidative enzymes. In comparison, castor oil cake (b) causes moderate browning, indicating a limited antioxidant effect. Castor oil alone (c) visibly improves the appearance of the fruit, with preserved coloration and reduced browning, demonstrating its protective effect. This result is consistent with the high peroxidase activity observed in the enzymatic analyses. The cake & oil treatment (d) shows more pronounced browning, probably due to a negative interaction or partial inhibition of the protective effects of the oil. Overall, castor oil alone appears to strengthen antioxidant defenses by stimulating peroxidase activity, while the cake & oil mixture appears to be the most promising treatment for limiting post-harvest browning of fruit.

DISCUSSION

This study is part of a broader effort to promote agricultural sustainability and autonomy, with the aim of improving organic production practices that contribute to enhancing the quality of vegetable crops while limiting dependence on chemical inputs. The nutritional parameters evaluated include crude fiber and energy value. The results show that the negative control has the highest fiber content (7.45%), while the meal & oil combination reduces this content to a minimum (6.68%). This suggests that castor-based inputs, particularly when combined, influence cell structure by limiting fiber synthesis. In terms of energy value, castor oil

alone maintains high energy (429.41 Kcal/100g DM), probably due to its lipid content (11.49%). Overall, the treatments result in a decrease in energy value, indicating a redistribution of nutrients. The fiber values obtained are lower than those obtained by AffissataFathim et al., (2024) (9) which stipulate that the fiber content of fresh eggplant is 24.75%. These figures are higher than those provided by (Collonnier et al., 2009 ; Michel et al., 2024) (10) et (11), which state that the fiber content of eggplant is around 1.34%. Previous studies have reported that the fiber content of fresh eggplant normally varies between 2.7% and 3% of fresh weight, depending on the variety (Jing et al., 2015) (12). As for physical properties: dry matter, moisture, and ash, the results show that the negative control and the cake promote the accumulation of dry matter (12.25% and 12.07%), while the oil and its combination increase moisture (91.32% and 90.64%). This suggests that the meal strengthens the cell structure, while the oil prevents fruit dehydration. These moisture values are slightly lower than those found by (Collonnier et al., 2009 ; Michel et al., 2024) (10) et(11)which report that the moisture content of fresh eggplant varies between 92.7 and 93.3%. No significant variation was observed in ash content, indicating that the treatments did not alter the overall mineral composition. Biochemical analyses focused on proteins, lipids, and total and energy carbohydrates. Castor meal strongly stimulates protein production (21.26%), probably due to its organic nitrogen content, while the control sample shows a significant deficiency (0.18%). In terms of lipids, castor oil and the meal & oil mixture increase their content (11.49% and 10.64%), which corresponds to their lipid nature. The negative control and the meal alone have a lesser effect (8.13% and 8.21%). For total and energy carbohydrates, the negative control has a high carbohydrate concentration (91.68%), which may reflect an accumulation due to reduced metabolic activity. Castor-based treatments promote protein and lipid synthesis, thereby reducing the amount of carbohydrates to 76.05% for the meal & oil combination, 70.95% for castor oil, and 70.52% for castor meal. These results are consistent with the conclusion of AffissataFathim et al., (2024) (9) which state that the total carbohydrate content of eggplant is 63.17%. Among the intrinsic factors affecting the shelf life of eggplant, water content and the presence of the enzyme polyphenol oxidase (PPO) play a very important role. In the present study, peroxidase is significantly stimulated by castor oil (15,180 U/g. MF for a period of 3 minutes), thereby strengthening antioxidant defenses. Polyphenol oxidase is higher in the negative control and castor meal alone (12.15 U/g. MF and 12.07 U/g. MF). These results are lower than those given by (Collonnier et al., 2009 et Michel et al., 2024) (10) et (11) which stipulate that the content of eggplant fruit can vary from 20 U/g.MF to 480 U/g.MF. They are higher than the values given by Jing et al., (2015) (12) who obtained values between 2 and 10 U/g.MF in their study. In terms of enzymatic browning, the application of oil visibly reduces this phenomenon, probably due to the stimulation of peroxidase. The meal & oil mixture seems less effective in this regard, which could be explained by an antagonistic effect. In summary, castor-based treatments significantly alter the nutritional, physical, and biochemical properties of eggplant. The cake promotes protein synthesis and dry matter, while the oil improves lipid content, moisture, and antioxidant mechanisms. The combination of meal and oil has synergistic or antagonistic effects depending on the parameters studied, requiring further research to optimize its use according to the objectives (preservation, processing, nutritional improvement).

CONCLUSION

Castor-based treatments had a significant impact on the nutritional, physical, and enzymatic properties of eggplant. Castor meal improved the protein content of the fruit, while castor oil, alone or combined with meal, increased their lipid concentration. In contrast, the negative control showed higher levels of fiber, carbohydrates, and energy, suggesting a possible nutritional imbalance without external inputs. Physically, castor meal and the negative control promoted increased dry matter content, which could improve the post-harvest storage of eggplants. Conversely, castor oil and its combination with meal preserved high moisture content, which is beneficial for freshness but less suitable for prolonged storage. Finally, on an enzymatic level, castor oil stimulated the activity of peroxidase, an enzyme essential for antioxidant defense, while reducing enzymatic browning of the fruit. The combination of cake and oil seems promising for limiting this browning, although its enzymatic interaction is more complex.
In general, the integration of cake and castor oil into eggplant cultivation is thus an innovative approach to optimizing the nutritional value of the fruit while enhancing peroxidase activity and reducing polyphenol oxidase activity.

Conflict of interest: The authors declare that they have no conflict of interest.

Contributions of authors: Paul Windinpsidi SAVADOGO participated in the design and planning of the experiments. Lancinè SANGARE supervised the work. Mamadi Mariame CAMARA conducted the experiment at the research station, collected the empirical data, analyzed it in the laboratory, and processed it. He also wrote the manuscript and submitted it to Lancinè SANGARE and Paul Windinpsidi SAVADOGO for review. All authors approved the final version of the manuscript.

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