RESEARCH ARTICLE

PRODUCTIVITY AND PROFITABILITY OF NATIVE PIGS *(Sus Scrofa)* SUPPLEMENTED WITH GOLDEN APPLE SNAIL *(Pomacea Canaliculata)* SILAGE

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ABSTRACT

This experiment following the Completely Randomized Design was conducted to determine the productivity and profitability of native pigs (*Sus scrofa*) supplemented with Golden Apple Snail (GAS) silage. It was conducted at Sitio Baulan, Murtha, San Jose, Occidental Mindoro from July 2022 to December 2022. Twenty experimental native pigs were used. These were randomly distributed in four treatments with five replications with one piglet per experimental unit. Native pigs were supplemented with GAS silage following the treatments. T0 = rice bran + forage, T1 = rice bran + 5% of GASS + forage, T2 = rice bran + 10% of GASS + forage and T3 = rice bran+ 15% of GASS + forage.

Results revealed that inclusion of 15% GAS silage (T3) improved native pigs' productivity in terms of gain in weight and feed conversion efficiency. It also revealed that different amounts of GAS silage increased the profitability of native pigs in terms of net income and return on investment (ROI).

Fifteen percent (15%) inclusion of GASS on rice bran is therefore recommended. Also, Follow-up studies to include meat yield and quality should be undertaken.

Keywords: *golden apple snail, silage, native pigs, productivity, profitability*

INTRODUCTION

One of the common breeds of pigs raised in backyard farms is the Philippine native pigs (*Sus scrofa philippinensis*). It is a small black pig with straight to low-set back and short legs and has a long snout and small and erect ears (Manipol et al., 2014). Since Philippine native pigs are well-adapted to the country's environmental condition, they do not require expensive housing and minimal care, which makes them easier and cheaper to raise than commercial breeds (Guerrero III, 2016).

According to DOST-PCAARRD (2017), native pig provides much importance in terms of additional income, high quality protein food, and socio-cultural and economic services; particularly during cultural celebrations and ceremonies. Other characteristics of native pig are its adaptability to local environment conditions; apparent resistance to diseases; and the unique texture and taste of its meat. There are enough reasons to invest on research and development (R&D) initiatives to improve the country's native pig.

In Occidental Mindoro, one of the best characteristics of native pigs is its ability to use local feed sources such as rice bran), cassava and taro root to survive (Santiago, 2018). According to the findings, using rice bran can influence and contribute to the growth and weight of native pigs. However, several farmers are still hesitant to engage in native pig production because of their perception that it is not a profitable venture (Cabriga, 2016). However, lechon or whole roasted pig is still the most popular dish and an important status symbol for large family gatherings. Native hogs are said to have the best flavor, giving free-range farmers having opportunities to expand both locally and globally (Yan, 2020). The province of Quezon, being the biggest source of native pigs for the lechon market, shipped out 67,227 heads in 2014. This includes pigs of both local and external origins. Of this total, 60,320 heads came from various municipalities while 6,907 heads were procured by seven Quezon traders from Burias Island, Masbate (1,835 heads), Marinduque (4,790 heads), and Mindoro (282 heads) (Bureau of Agricultural Research, 2014). According to Jawa et al. (2020), which showed that adding golden snail meat flour 15% (R3) in broiler chicken rations tend to give the best results on feed conversion with an average of 1.87. This is because the consumption of rations in treatment R3 is lower than other treatments so that it can affect the feed conversion efficiency value. The giving of golden snail meat flour in broiler chicken rations has a very significant effect on increasing weight gain, final body weight, and decreasing Feed Conversion Ratio (FCR) and significantly influencing the consumption of rations, giving GAS meat flour in rations can increase weight gain and final body weight of pigs.

According to Kaensombath (2005), making silage from apple snail meat has been described as a low cost and simple method for small- scale production because snail meat contains mostly protein and minerals, the addition of a source of carbohydrates such as molasses or rice bran is required for making good silage. Golden apple snail, though considered a pest in the Philippines, may be made beneficial through fermentation. In that way, golden apple snail will not be famous as being detrimental, but instead, it can be useful in the near future. Fermentation profile was used to predigest the fibrous protein in golden apple snail meat and preserve the golden apple snail nutritional profile (Rattanaporn et al., 2006). Supplementation of fermented golden apple snail has a great potential in the production

performance of native chicken (Buctot Jr., 2018). However, during the review, it was found out that there was limited document that provide information with regards to the productivity of native pigs of Occidental Mindoro supplemented with fermented golden apple snail. It is in this context that this study was conceptualized to determine the productivity and profitability of native pigs supplemented with Golden Apple Snail Silage (GASS).

Generally, this study aimed to determine the productivity and profitability of native pigs supplemented with GASS as protein supplement. Specifically, this study intended to: (a) determine the productivity of native pigs supplemented with golden apple snail silage, in terms of gain in weight; feed consumption; and feed conversion efficiency; (b) Analyze the profitability level of native pigs supplemented with golden apple snail silage, in terms of: net income; and return on investment; (c) Find out the best inclusion rate of golden apple snail silage.

MATERIALS AND METHODS

Materials

Table 1a presents the materials that were used in the course of this research. It includes the materials' quantity, unit, and description.

Table 1. Materials used in the study.

Quantity	Unit	Particular
20	Head	Piglets (one month old native, 2-3 kilos)
31	Kilogram	Golden Apple Snail
31	Kilogram	Molasses
11	Bag	Rice bran (50kg per bag)
1	Piece	Digital weighing scale (5000g capacity)
1	Piece	Crane scale (50kg capacity)
3	Piece	Pail (10L capacity)

Research Design

This study was experimental in nature. It followed the Completely Randomized Design (CRD) to determine the productivity of native pigs supplemented with golden apple snail silage. There were four treatments replicated five times and one piglet in every experimental pen, with a total of 20 piglets.

Experimental Lay out

Twenty pens were used in this study. It was separated into two sections, each division had 10 experimental units which served as treatment per replication.

T_3R_5	T_2R_4	T_3R_3	T_2R_3	T_0R_4	T_1R_1	T_0R_3	T_2R_2	T_3R_2	T_1R_3
T_0R_5	T_3R_4	T_1R_5	T_1R_2	T_1R_4	T_2R_5	T_2R_1	T_3R_1	T_0R_2	T_0R_1

Fig. 1. Experimental layout.

Preparation of Golden Apple Snail Silage

The procedure used by Barroga (2004) was adapted in the preparation of Golden Apple Snail (GAS) silage. The golden apple snails were collected from the pond and rice field in Central, San Jose, Occidental Mindoro. The GASS was prepared by boiling for 30 minutes, then removed meat using a stick. The GAS meat was mixed with molasses and allowed to ferment for 30 days.

Experimental Management Practices

Housing Preparation

The experimental house of the native pigs was made up of locally available materials. Partitions walls were made up of bamboo while roof was *buri* leaves. The housing was divided into 20 experimental pens with alley at the middle. Each experimental pen has a measurement of 4 x5 feet with concrete feeding and watering through.

Procurement of Stock

Native piglets were procured from the Indigenous people of Bato-Ili, Monteclaro, San Jose, Occidental Mindoro. Experimental piglets were active, weighed abou2-3 kilos, 35- 45 days of age and with no signs of diseases. Piglets were acclimatized for seven before they were randomly distributed to the treatments and replicates.

Management Practices

Feeds and Feeding

The same care and management were given to test animals except for the amount of GAS Silage. On the first 7 days, experimental native pigs were fed with rice bran. On the 8^{th} day, GAS silage was introduced using the following ratio: Control group pure rice bran + forage, T1= rice bran+5% GASS + forage, T2= rice bran+10% GASS + forage, and T3 = rice bran+ 15% GASS + forage.

Water Management

All experimental native pigs were given clean water. Water was supplied frequently to make the native pigs hydrated at all times due to the warm environmental conditions. All watering trough were regularly cleaned.

Diseases and Pest Management

Native pigs were dewormed twice using commercial dewormer. Oral anthelminthic was given 3 days upon arrival of the piglets and three weeks before the end of study. No vaccination and other vet drugs were administered.

Sanitation and Waste Management

The experimental area was cleaned daily using cleaning materials. Shovel was used to collect the feces and it were placed in the composting pit covered with other organic litter and rice hull. Hence, the native pig house was far away from household to avoid distraction and to minimize the unpleasant odor.

Data Gathering

The following was carefully observed and recorded to serve as basis for analysis and evaluation of productivity and profitability of native pigs supplemented with golden apple snail silage.

1. **Initial weight –** This was collected by getting the weight of native pigs before the start of experimentation with the use of crane scale.
2. **Final Live weight –** This was obtained by getting the total weight of native pigs after 120 days of experimentation.
3. **Gain in Weight –** This was obtained by subtracting the initial weight from the final weight of the native pigs after 147 days of growing period. Mathematically, it is expressed as: Gain in weight = Final live weight – Initial weight
4. **5. Feed Consumption (FC) –** This was obtained daily by getting the difference between the amounts of feeds given with the amount of feed left. This was obtained using the weighing scale and was recorded in kilograms. Mathematically, it is expressed as: FC = Amounts of feeds given – Amounts of feeds left
5. **Feed Conversion Efficiency –** This was obtained by dividing the total amount of feeds consumed with the gain in weight. Mathematically, it is expressed as: FCE = Total amount of feed consumed / Total gain in weight
6. **Net Income.** It refers to the profit after four months. In this study, it was calculated by getting the difference of the total expenses with the total sales.
7. **Return on Investment.** It refers to the financial ratio that measures the gain or loss from an investment in relation to the initial investment. This often used to determine the profitability of an expenditures. In this study, proponents used this formula: ROI = Net Income / Total Expenses x 100%

RESULTS

Gain in Weight

Table 2a presents the gain in weight of the native pigs supplemented with golden apple snail silage for the period of 147 days. It can be noticed from the table that in experimental native pigs in Treatment 3 provided with rice bran + 15% golden apple snail silage registered highest mean gain in weight of 11.52 kg. It was followed by T1, and T2 with the means of 10.88 kg, 9.90 kg respectively. On the other hand, Control group treated with rice bran + forage registered the lowest mean of 8.26 kg. This suggests that the inclusion of rice bran + 15% of golden apple snail silage improve the gain in weight of the native pigs. This can be attributed to the fact that golden apple snail silage is rich in protein and other nutrients which are needed by pigs for them to grow.

Table 2a. Gain in weight (kg) of experimental native pigs supplemented with golden apple snail silage for the period of 147 days.

Treatments	Gain in Weight					Treatment Total	Treatment Mean
	R_1	R_2	R_3	R_4	R_5		
T_0 (RB+forage)	10.2	7.8	7	8	8.3	41.3	8.26
T_1 (RB+5% GASS+forage)	11.4	13.6	8.7	13.6	7.1	54.4	10.88
T_2 (RB+10%GASS+forage)	9.7	8.3	10.2	11.2	10.1	49.5	9.90
T_3 (RB+15%GASS+forage)	11.6	10	12.6	13	10.4	57.6	11.52
Grand Total						**202.8**	
Grand Mean							**10.14**

Feed Consumption

Table 3a presents the feed consumption of experimental native pigs applied with different amounts of golden apple snail silage for the period of 147days. It can be observed that native pigs in Treatment 3 rice bran +15% GASS + forage has the highest feed consumption with a mean of 42.44 kg. This was followed by Treatment 2 rice bran +10% GASS + forage with a mean of 42. 20 kg, and control group rice bran + forage obtained a mean of 41.40 kg. On the other hand, least feed consumption was from Treatment 1 rice bran + 5% GASS + forage with a mean of 41. 31 kg. This suggests that the inclusion of rice bran + 15% of golden apple snail silage slightly improved the appetite of the native pigs.

Table 3a. Feed consumption (kg) of experimental gain in weight (kg) of experimental native pigs supplemented with golden apple snail silage for the period of 147 days.

Treatments	Feed Consumption					Treatment Total	Treatment Mean
	R_1	R_2	R_3	R_4	R_5		
T_0 (RB+forage)	41.38	41.71	41.30	41.18	41.45	207.02	41.40
T_1(RB+5%GASS+forage)	41.96	42.41	38.58	42.26	41.33	206.56	41.31
T_2 (RB+10%GASS+forage)	42.18	41.44	42.64	42.69	42.06	211.02	42.20
T_3 (RB+15% GASS+forage)	42.42	42.21	42.76	42.43	42.37	212.19	42.44
Grand Total						**836.79**	
Grand Mean							**41.84**

Feed Conversion Efficiency (FCE)

Table 4a presents the feed conversion efficiency of experimental native pigs applied with different amounts of golden apple snail silage for the period of 147 days. As presented in Table 4a, results revealed that native pigs in Treatment 3 applied with rice bran +15% golden apple snail silage +forage had the highest feed conversion efficiency of 3.72. This takes a significant difference with other treatments. Further, Treatment 1 rice bran +5% golden apple snail silage + forage registered the mean of 4.03 which is second to the highest FCE. On the other hand, control group registered the lowest feed conversion efficiency with the mean of 5.08 which is comparable to the Treatment 2 rice bran + 10% golden apple snail silage + forage

with a mean of 4.30. This implied different amount of GASS increased and improved the FCE of experimental native pigs.

Table 4a. Feed conversion efficiency (kg) of experimental native pigs supplemented with different amounts of GASS for the period of 147 days.

Treatments	Feed Conversion Efficiency					Treatment Total	Treatment Mean
	R_1	R_2	R_3	R_4	R_5		
T_0 (RB+forage)	4.06	5.35	5.90	5.15	4.99	25.44	5.08[a]
T_1 (RB+5% GASS+forage)	3.68	3.12	4.44	3.11	5.82	20.16	4.03[b]
T_2 (RB+10% GASS+forage)	4.35	4.99	4.18	3.8	4.16	21.49	4.29[ab]
T_3 (RB+15% GASS+forage)	3.66	4.22	3.39	3.26	4.07	18.61	3.72[b]
Grand Total						**85.72**	
Grand Mean							**4.28**

ab= Means with the same letter are not significantly different.

Net Income

Table 5a presents the net income of experimental native pigs as affected by different amounts of GASS. It can be noted that Treatment 3 attained the highest net income (PhP 742.70). This was followed by Treatment 1 and Treatment 2, which obtained (PhP707.15) and (PhP406.46) respectively. On the other hand, control group (PhP81.44) gained the lowest net income. This implies that T3, T1 and T2 is higher than T0 (control). It indicates that T3 (9.11 times) higher than T0. It was followed by T1 (8.68 times) and T2 (4.99 times) respectively. This means that different amounts of GASS was profitable. Though expenses are higher, it ensures higher returns.

Table 5a. Net income (PhP) of experimental native pigs supplemented with golden apple snail silage.

Treatment	Sales	Expenses	Net Income (PhP)
T_0 = rice bran + forage	PhP11,340.00	PhP10,932.82	81.44
T_1 = rice bran + 5% GASS +forage	PhP14,595.00	PhP11, 059.24	707.15
T_2 = rice bran + 10% GASS+ forage	PhP13,230.00	PhP10, 597.66	406.46
T_3 = rice bran + 15% GASS+forage	PhP15,036.00	PhP11, 322.48	742.70

Note: Cost of Native pigs per kg- live weight (PhP210.00)

Return on Investment

Return on Investment is determined by dividing the net income by the total expenses and multiplied by 100%. Table 5b presents the Return on Investment (ROI) of experimental native pigs supplemented with golden apple snail silage. It can be noted that the Treatment 3 attained the highest ROI (32.80%). This was followed by Treatment 1 (31.97%), Treatment 2 (18.15%) while Control group gained the lowest ROI which is (3.72%).

Table 5b. Return on Investment (ROI) of experimental native pigs supplemented with golden apple snail silage.

Treatment	Net Income (PhP)	Return on Investment (%)
T_0 = rice bran + forage	81.44	3.72
T_1 = rice bran + 5% Golden Apple Snail Silage + forage	707.15	31.97
T_2 = rice bran + 10% Golden Apple Snail Silage + forage	406.46	18.15
T_3 = rice bran + 15% Golden Apple Snail Silage + forage	742.70	32.80

The Analysis of Variance in CRD (Table 2b) for the gain in weight as affected by different amounts of GASS revealed no significant difference among treatment means. The computed F- value of 3.15 is lower than the critical F- value of 3.24 at 5% level of significance, therefore, it failed to reject the null hypothesis. This implied that different amounts of GASS is the same effect with the control.

Table 2b. Analysis of Variance in Completely Randomized Design for gain in weight of experimental native pigs supplemented with golden apple snail silage for the period of 147 days.

Source of Variation	Degree of Freedom	Sum of Square	Mean Square	Computed F-value	F critical
Treatment	3	30.22	10.07	3.15^{ns}	3.24
Error	16	51.09	3.19		
Total	19	81.31			

ns= not significant; CV = 17.62%

However, the Analysis of Variance in Completely Randomized Design (Table 3b) for the feed consumption as affected by different amounts of golden apple snail silage revealed no significant difference among treatment means. It is indicated by the computed F- value of 2.26 which is lower than the critical F- value of 3.24 at 5% level of significance. Therefore, it failed to reject the null hypothesis. This implied that different amounts of golden apple snail silage did not affect to the experimental native pigs.

Table 3b. Analysis of Variance in Completely Randomized Design for feed consumption of experimental native pigs supplemented with golden apple snail silage for the period of 147 days.

Source of Variation	Degree of Freedom	Sum of Square	Mean Square	Computed F-value	F critical
Treatment	3	4.80	1.60	2.26^{ns}	3.24
Error	16	11.33	0.71		
Total	19	16.13			

ns = not significant; CV = 2.01%

Table 4b shows the ANOVA for feed conversion efficiency. It registered a calculated F-value of 3.26 which is higher than the critical value of 3.24 at 5 % level of significance. Thus, the null hypothesis is rejected. This indicates that feed conversion efficiency was influenced by the different amounts of GASS in experimental native pigs. This implies that T3 (rice bran + 15% golden apple snail silage + forage) showed better FCE. The findings corroborated with the study of Jawa, Suwitari, & Sanjaya (2020), that adding GAS meat flour 15% (R3) in broiler chicken rations tends to give the best results on feed conversion. This is because the consumption of rations in T3 is lower than other treatments so that it can affect the FCE value. The giving of GAS meat flour in broiler chicken rations has a very significant effect on increasing weight gain, final body weight, and increasing FCR (Feed Conversion Ratio) and significantly influencing the consumption of rations, giving GAS meat flour in rations can increase weight gain and final body weight.

Table 4b. Analysis of Variance in Completely Randomized Design of FCE of experimental native pigs supplemented with GASS for the period of 147 days.

Source of Variation	Degree of Freedom	Sum of Square	Mean Square	Computed F-value	F critical
Treatment	3	5.14	1.72	3.26*	3.24
Error	16	8.43	0.09		
Total	19	13. 57			

**significant; CV = 16.93%*

DISCUSSION

The findings presented in this study offer valuable insights into the effects of supplementing native pigs with golden apple snail silage (GASS) on various parameters relevant to pig farming. These findings have implications for both small-scale and commercial pig production.

The observed increase in weight gain among native pigs when supplemented with GASS, particularly at a 15% inclusion rate, suggests that GASS can be considered an effective dietary component for enhancing the growth of native pigs. The improved weight gain can be attributed to the protein and nutrient content of GASS, which complements the dietary requirements of the pigs for growth. This finding supports the notion that GASS silage is a valuable resource for pig farmers looking to improve the performance of their animals Cromwell, 2015).

The study also revealed that native pigs fed a diet including GASS showed slightly increased feed consumption, indicating improved appetite. This suggests that GASS can have a positive impact on the palatability of the diet. Enhanced feed intake is crucial for meeting the nutritional demands of pigs, especially in intensive production systems. The increased feed consumption in the presence of GASS may contribute to the observed weight gain, making it an advantageous feed supplement for pig farming (Rodrigues et al., 2022).

Treatment 3, which included rice bran and 15% GASS, demonstrated the highest FCE. This finding is significant as FCE is a critical parameter in pig farming. A lower FCE value

indicates that pigs are converting feed into body weight more efficiently, which is a desirable trait for economic and sustainable pig production. The results suggest that the inclusion of GASS in pig diets, particularly at a 15% rate, can significantly improve the FCE of native pigs, potentially reducing feed costs and environmental impact (Patience et al., 2015).

While this study focused on native pigs, the positive impact of GASS supplementation on weight gain, feed efficiency, and economic returns has broader implications for livestock farming. These findings suggest that GASS can be a beneficial feed supplement for other livestock species, potentially improving overall production efficiency and profitability (Delsart et al., 2020). The study's results align with previous research, such as the work of Jawa et al. (2020), which supports the notion that GASS can improve feed conversion and weight gain in livestock. This consistency reinforces the validity of the findings and their practical applicability. The findings of this study underscore the potential benefits of incorporating golden apple snail silage into the diets of native pigs. The improved weight gain, feed efficiency, net income, and ROI associated with GASS supplementation make it a promising option for pig farmers seeking to enhance the performance and profitability of their operations. These findings contribute to the growing body of knowledge on alternative and sustainable feed resources for livestock and highlight the potential of GASS in livestock farming. Further research and on-farm trials are recommended to confirm and extend these findings, particularly in different pig production systems and regions.

While the findings of this study offer valuable insights into the potential benefits of supplementing native pigs with golden apple snail silage (GASS), it is essential to acknowledge several limitations that may affect the generalizability of the results. This study focused exclusively on native pig populations and their response to GASS supplementation over a 147-day period. The results may not fully represent the effects of GASS on other pig breeds or longer-term feeding scenarios. Therefore, caution should be exercised when extrapolating these findings to diverse pig populations and extended production cycles. The study did not account for potential environmental variability, such as climatic conditions, which could influence pig performance and feed requirements. Different regions and seasons may yield varying results when implementing GASS in pig diets. Thus, the outcomes presented here may not be universally applicable and should be interpreted within a specific context. In light of these limitations, it is crucial for future research to expand the scope, consider environmental variability, and investigate the practical application of GASS in diverse pig farming settings. This will help provide a more comprehensive and realistic assessment of the impact of GASS supplementation on native pigs and other livestock species, ultimately contributing to more informed and context-specific recommendations for livestock management practices.

CONCLUSIONS

Considering the pertinent findings, the researchers drew several conclusions regarding the impact of golden apple snail silage on the productivity and profitability of raising native pigs. Firstly, it was observed that the utilization of varying amounts of golden apple snail silage had a positive effect on the feed conversion efficiency (FCE) of the native pigs, contributing to improved productivity. Secondly, the inclusion of different quantities of golden apple snail silage

was found to enhance the overall profitability of raising native pigs. Notably, the study identified that a 15% inclusion rate of golden apple snail silage emerged as the most optimal, suggesting that this level of incorporation yielded the best results in terms of both productivity and profitability in native pig farming. These findings have significant implications for optimizing the utilization of golden apple snail silage in the swine industry, promoting economic sustainability and efficient resource management.

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