Milk Yield of Dairy Buffaloes Supplemented with Yeast Solution and Yeast-fermented Cassava Pulp

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(received 18-11-2021; revised 27-01-2022; accepted 31-01-2022)

ABSTRAK

Tapdasan EP, Salces CB, Salces AJ. 2021. Produksi susu kerbau yang disuplemenasi larutan ragi teraktifasi dab ransum dengan bubur singkong fermentasi ragi. JITV 27(1):1-9. DOI: http://dx.doi.org/10.13443.

Ketersediaan dan kualitas sumber pakan adalah dua faktor utama yang membatasi produksi susu di Filipina. Pemanfaatan pakan tambahan berbasis mikroba dan produk samping pertanian seperti ampas singkong dengan bantuan teknologi fermentasi dapat membantu menyediakan sumber daya yang dibutuhkan. Penelitian ini bertujuan untuk mengetahui pengaruh larutan ragi aktif (*Saccharomyces cerevisiae*) (AYS) dan bubur singkong fermentasi ragi (YFCP) terhadap produksi susu dan efisiensi biaya pakan pada kerbau perah. Penelitian mengikuti desain RCBD menggunakan 63 ekor kerbau perah di Pusat Carabao Filipina di Ubay Stock Farm, Bohol. Rata-rata produksi susu harian (ADMY) kerbau yang diberi suplemen 0,5L AYS dan 1L AYS dua kali sehari lebih besar daripada kerbau kontrol masing-masing sebesar 0,67L dan 0,69L (P = 0,0039). Sebaliknya, ADMY kerbau yang diberi pakan YFCP dan YFCP+AYS lebih besar dari kerbau kontrol masing-masing sebesar 0,64 dan 0,68L (P = 0,0320). Suplementasi AYS dan pemberian makan YFCP menghasilkan biaya terendah per liter susu yang diproduksi pada PhP 20,25 dan PhP 16,24, masing-masing. Direkomendasikan untuk melengkapi pemerahan kerbau dengan AYS atau memberi makan YFCP di daerah dengan ampas singkong untuk meningkatkan sumber pakan, meningkatkan produksi susu dan meningkatkan efisiensi biaya pakan sehingga meningkatkan pendapatan peternak secara signifikan.

Kata Kunci: Kerbau, Singkong, Susu, Bubur, *Saccharomyces cerevisiae*

ABSTRACT

Tapdasan EP, Salces CB, Salces AJ. 2021. Milk Yield of dairy buffaloes supplemented with activated yeast solution and fed ration with yeast-fermented cassava pulp. JITV 27(1):1-9. DOI: http://dx.doi.org/10.13443.

Feed resource availability and quality are two of the major factors limiting dairy production in the Philippines. Utilization of microbial-based feed additives and agricultural by-products such as cassava pulp aided by fermentation technology can help provide the needed resource. This study aimed to determine the effect of activated yeast (*Saccharomyces cerevisiae*) solution (AYS) and yeast-fermented cassava pulp (YFCP) on milk production and feed cost-efficiency in dairy buffaloes. The study followed RCBD design using 63 dairy buffaloes at the Philippine Carabao Center in Ubay Stock Farm, Bohol. The average daily milk yield (ADMY) of buffaloes supplemented with 0.5L AYS and 1L AYS twice daily were greater than that of control buffaloes by 0.67L and 0.69L, respectively (P = 0.0039).On the other hand, the ADMY of buffaloes fed with YFCP and YFCP+AYS were greater than that of control buffaloes by 0.64 and 0.68L, respectively (P = 0.0320). Supplementation of AYS and feeding YFCP yielded the lowest cost per liter of milk produced at PhP 20.25 and PhP 16.24, respectively. It is recommended to supplement milking dairy buffaloes with AYS or feeding YFCP in areas with cassava pulp to increase feed resource, increase milk production and improve feed cost-efficiency thereby increasing significantly the farmer's income.

Key Words: Buffaloes, Cassava, Milk, Pulp, *Saccharomyces cerevisiae*

INTRODUCTION

Dairying is one of the opportunities that provides livelihood to farmers in the Philippines including the Visayas region. In the latest dairy industry performance report of the Philippine Statistics Authority (PSA 2016), the total dairy animal population in the country in 2015 stood at 44,432 head. This was 6.34 percent higher than in the previous year (2014). Dairy cattle stocks grew by 8.95 percent, while dairy buffalo and dairy goat population went up by 2.91 percent and 6.75 percent, respectively (PSA 2016).

Despite the growth of the dairy animal population, there are some limitations besetting the dairy industry. FAO (2021) reported that one of the major factors limiting dairy production is the poor-quality of feed resources particularly low digestibility and nutritive value. In tropical countries, ruminants are mostly grazed on pasture areas with low quality grasses and forages, thereby limiting their potential for growth and milk production (Arowolo & He 2018). With this reality, there is a growing interest to improve the quality and digestibility of these feed resources. In light of this, many studies have reported the positive effects of probiotics (Arowolo & He 2018) as a supplement that is known to improve nutrient availability of poor quality feed resources. Probiotics are also known to improve dry matter feed intake and feed conversion efficiency and enhance nutrient utilization efficiency. Moreover, they stimulate and activate immune cells, reducing methane production thereby minimizing energy loss and generally promote growth and health performance as well as meat and milk production in ruminants (Arowolo & He 2018) Considered as probiotics, yeasts (*Saccharomyces cerevisiae*) are microscopic fungi that reproduce by budding and convert sugar into alcohol and carbon dioxide. In the rumen, live yeast consumes oxygen which is favorable for the growth of anaerobic rumen microbes. Feeding live yeast to ruminants has been empirically known to improve productivity, by optimizing the fermentation conditions of the rumen, stabilizing ruminal pH, improving feed efficiency and increasing fiber digestion (Mazzia & Walker 2008; Fortina et al. 2011). Yeasts can improve rumen function by enhancing feed components, thereby improving milk production while ensuring digestive comfort and health of the animal (Maamouri et al. 2014). In Thailand, Wanapat et al. (2011) reported improved performance in terms of milk production and rumen condition of dairy cattle fed with baker's yeast-fermented cassava which replaced soybean oil meal in the diet. In addition, a local study in goats by Abela & Bestil (2013) reported that laboratory cultured yeast supplementation could enhance rumen pH and bacterial count, increase dry matter intake and digestibility of napier grass-concentrate ration. As a result, there was improved growth rate in newly weaned goats.

On the other hand, cassava pulp, a by-product of cassava starch production can be used as animal feeds. The by-product was abundant in Bohol and was used for feeding to dairy buffaloes of the Philippine Carabao Center in Ubay, Bohol. However, according to Aro (2008), its protein content of approximately 2%, deficiency in carotene and high levels of insoluble fiber makes it unable to support high milk production. The use of cassava pulp was appropriate under Bohol conditions since there were plenty of cassava plantations in the province propelled by the presence of a big starch manufacturing company. On the other hand, yeast (*S. cerevisiae*) was widely available in supermarkets being commonly used in bread making. Feeding dairy buffaloes with yeast-fermented cassava pulp was expected to increase milk production and reduce feed cost while maximizing the utilization of the locally available by-product thereby increasing the dairy farmer's income.

There were no reports concerning the effects on the utilization of direct feed microbe and yeast-fermented cassava pulp for dairy buffaloes under Philippine condition. Generally, the study aimed to increase milk production and profitability by the utilization of baker's yeast (*S. cerevisiae*) as a direct feed microbe and yeast-fermented cassava pulp as feeds in dairy buffaloes. Specifically, it aimed to determine the effect of activated yeast solution (AYS) supplementation in milk yield of dairy buffaloes, determine the effect of yeast-fermented cassava pulp (YFCP) feeding on milk yield of dairy buffaloes, and measure the feed cost-efficiency of supplementing AYS and feeding YFCP in dairy buffaloes. Dairy buffalo was used as the study unit since it was the most common dairy animal raised by small hold farmers in the country.

MATERIALS AND METHODS

Location

The study was conducted at the Institutional Farm of the Philippine Carabao Center at Ubay Stock Farm (PCC-USF) in Ubay, Bohol, Philippines. The farm is located at 9°59'34"N and 124°26'26"E (GPS coordinates).

Materials

Cassava pulp used in this experiment was purchased from a starch producing company in Carmen, Bohol (Liwayway Marketing Corporation). Molasses and commercial lactating feeds (Gromax®, Vitarich Corporation, Iloilo, Philippines) were purchased from the province of Cebu. On the other hand, the commercial baker's yeast (Mauripan®) manufactured by Xinjiang Mauri Food Company Limited in Xinjiang, China were sourced out from a local store in Ubay, Bohol.

Raw materials used in preparing cassava pulp-based feeds were sourced out from an accredited supplier of PCC-USF in Lanao del Norte (RM Longcob Enterprises) and Ubay, Bohol (Bohol Agrivet Supply). These raw materials were rice bran, copra meal, soybean meal, coconut oil, commercial vitamin-mineral premix, and mono-dicalcium phosphate. The whole experiment was performed following all applicable national laws on animal welfare.

Methodology to determine the effect of activated yeast solution on milk yield performance

Preparation of activated yeast solution (AYS)

Based on Boonnop et al. (2010) and preliminary trial results, AYS was prepared by mixing 20kg molasses, 100g baker's yeast and 100L clean drinking water. The solution was then stored in clean drums at room temperature and supplied with oxygen daily for twenty four (24) hours using an electric air pump.

Experimental design and supplementation of buffaloes

Twenty-seven (27) lactating Bulgarian Murrah Buffaloes (BMB) in mid-lactation stage (101-200 days in milk), at second to sixth parity, and having an average daily two (2)-week pretrial milk yield of at least 5 L per day were selected in such a way that the stage of lactation and average milk yield of the three treatment groups were more or less similar at the start of the experiment. The experiment was laid out in Randomized Complete Block Design (RCBD) with three treatments: Treatment 1- Control (No supplement), Treatment 2 – 500 mL AYS and Treatment 3 – 1000 mL AYS. There were three blocks per treatment. The blocking factor was date of the start of feeding experiment (Block 1: March 2017, Block 2: April 2017, Block 3: June 2017). All animals were allowed to graze at daytime and fed with napier silage during the night. Customized concentrate feeds (3 kg twice per day) and AYS were given during the morning and afternoon milking at 4:30 am and 2:00 pm, respectively.

Composition of customized concentrate feeds

To prepare the customized concentrate feeds, the following raw materials and their corresponding volume (kg) were mixed uniformly: copra meal (450), yellow corn grits (300), rice bran (145), commercial vitamin-mineral premix (50), molasses (30), tricalcium phosphate (15) and urea (10). The formulation was provided by the resident animal nutritionist of PCC-USF.

Methodology to determine the effect of YFCP on milk yield performance

Preparation of activated yeast solution (AYS)

The AYS was prepared by mixing 20kg of molasses and 100L of water, and added with 100g baker's yeast. The solution was incubated at room temperature and oxygen was supplied by an electric air pump for 24 hours.

Preparation of yeast fermented cassava pulp (YFCP)-based feeds

Cassava pulp, copra meal and other materials prepared according to formulation were mixed thoroughly using a shovel. The total mixed ration consisted of the following raw materials and their corresponding volume (kg): cassava pulp (771.43), copra meal (375), molasses (110), soybean meal (100), rice bran (75), commercial vitamin-mineral premix (40), coconut oil (20), mono-dicalcium phosphate (20) and urea (15). The mixture was then added with 0.5kg yeast dissolved in 32L molasses and 40L water. After 24 hours, ten (10) liters of Lactic Acid Bacteria Serum (LABS) were added to the feed mixture.

Preparation of LABS

To prepare LABS, the following raw materials and their corresponding volume were mixed thoroughly: clean water (200 L), rice wash (96 L) and molasses (32 L).

Experimental design and supplementation of buffaloes

Thirty six (36) BMBs in mid-lactation stage (101-200 days in milk), at second to sixth parity and having an average daily two (2)-week pretrial milk yield of at least 5 L per day were selected in such a way that the stage of lactation and average milk yield of the three treatment groups were more or less similar at the start of the experiment. The experiment was laid out in Randomized Complete Block Design (RCBD) with three treatments: Treatment 1- Control (3 kg commercial feeds, Gromax® by Vitarich Corporation, Iloilo, Philippines), Treatment 2 – 4 kg YFCP and Treatment 3 – 4 kg YFCP+ 1 L AYS. There were three blocks per treatment. The blocking factor was date of the start of feeding experiment (Block 1: January 15, 2018; Block 2: February 17, 2018; Block 3: February 23, 2018). All animals were allowed to graze at daytime and fed with napier silage during the night. The YFCP was fed during the morning and afternoon milking at 4:30 am and 2:00 pm, respectively.

Composition of commercial vitamin-mineral premix

Each 500 g of the commercial vitamin-mineral premix (Essential Vet Laboratories, Inc., Quezon City, Philippines) contained sodium selenite (100 mg), Vitamin A (150,000 IU), Vitamin D_3 (30,000 IU), Vitamin E (500 IU), potassium iodide (100 mg), cobalt sulfate (3 mg), manganese sulfate (3,700 mg), ferrous sulfate (1,600 mg), copper sulfate (1,500 mg) and zinc sulfate (220 mg).

Data gathering and analysis

Daily milk production records of all experimental animals were collected for eight weeks. Data were entered into Microsoft Excel® and analyzed using Statistical Analysis Software (SAS version 9.4, SAS Institute, Cary, NC, USA). A one-way Analysis of Variance (ANOVA) was performed after the data passed the test of homogeneity of variances. The Least Significant Difference (LSD) was then used as a post-hoc test. Mean difference was considered statistically significant at $P < 0.05$.

RESULTS AND DISCUSSION

Effect of activated yeast solution (AYS) on milk yield performance

Figure 1 shows that dairy buffaloes had higher milk yield at the start of the experiment (week 1) then slowly decreased as they reached the succeeding weeks of lactation. But among the three treatments, Treatment 1 (T1) had the highest drop in milk production when compared to Treatments 2 (T2) and 3 (T3) as the eighth week of data collection had been reached. This trend happened because normally, as the lactation advances to the last stage, milk production gradually drops. However, it is important to note that T2 and T3 buffaloes had higher average weekly milk yield as compared with T1 buffaloes or those without AYS supplementation.

After eight weeks of data collection, results showed that the average daily milk yield of T2 and T3 buffaloes were significantly greater than T1 buffaloes (control) by 0.67 L and 0.69 L, respectively ($P = 0.0039$) (Table 1). However, the results of post-hoc test (LSD) revealed no significant difference between the milk yields of T2 and T3. The result of the study were in consonance with the study of Anjum et al. (2018) in Pakistan wherein yeast supplementation has been proven to improve the milk yield performance of Nili-Ravi buffaloes. In Egypt, the study of Hansen et al. (2017) concluded that supplementation of yeast in buffaloes may result to increase milk yield during the early stage of lactation and would result to a more consistent milk production during the middle stage. Likewise, several authors claimed that yeast supplementation increases milk yield in dairy cows (Campanile et al. 2008; Yalçın et al. 2011; Ayad & Benallou 2013; AlZahal et al. 2014; Maamouri et al. 2014; Jiang et al. 2017)) including buffalo cows (Azzaz et al. 2015). The mechanism by which yeast increases milk yield were also explained by these authors. Yeast balances rumen ecosystem and increases ruminal cellulolytic bacteria (Jouany & Morgavi 2007; Wadhwa & Bakshi 2013; Jiang et al. 2017) thereby improving fiber digestion (Jouany & Morgavi 2007; AlZahal et al. 2014; Jiang et al. 2017; Bakr et al. 2015). Moreover, yeast increases digestibility of organic matter, crude protein, Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) (Jiang et al. 2017; Campanile et al. 2008) and lowers blood ammonia level (Campanile et al. 2008; Ogbuewu et al. 2019).

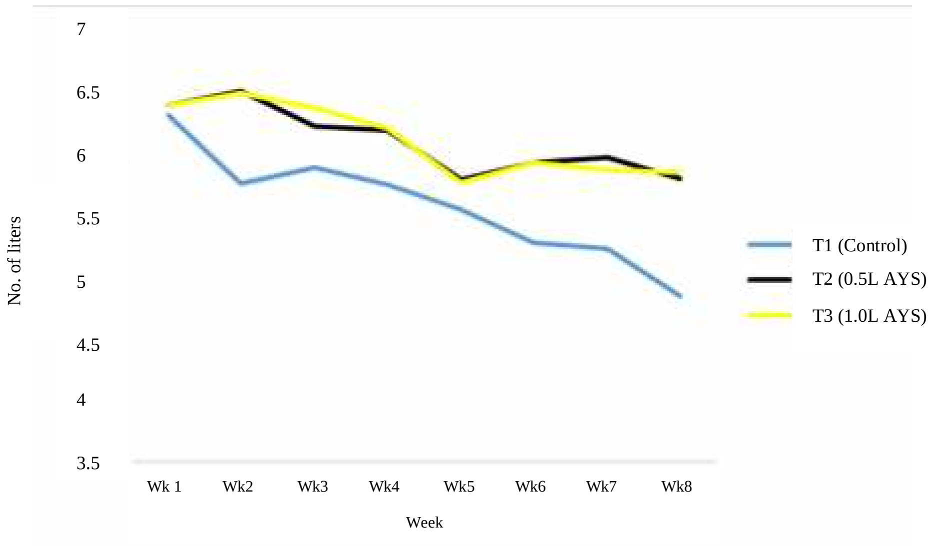

Figure 1. Average weekly milk yield of dairy buffaloes supplemented with 0.5L and 1L of activated yeast solution (AYS)

Aside from being high in crude protein, yeast increases amino acids particularly methionine, phenylalanine, tyrosine, tryptophan and taurine (Yalçın et al. 2011). Yeast is also a source of selenium and Vitamin B-complex (Maamouri et al. 2014) including Vitamin B1 (Ayad & Benallou 2013). A review on the beneficial effects of yeast on the production parameters of livestock including milk yield were compiled by Ogbuewu et al. (2019). Yeast reduces the population of pathogenic microorganisms in the gut, provides direct nutritional benefits and improves intake of feeds and uptake of nutrients from the gut (Ogbuewu et al. 2019).

Table 2 shows the daily total cost of feeding per animal using the three dietary treatments. It was shown that based on the prevailing price in 2018, T1 (Control) was cheaper than T2 by PhP 2.00 and cheaper than T3 by PhP 4.00. However, taking into consideration the cost of feeding to produce one (1) liter of milk per animal, T2 had the lowest cost at PhP 20.25 (Table 3). It was cheaper than T1 and T3 by PhP 2.19 and PhP 0.27, respectively.

To appreciate more the economic benefits of supplementing AYS, Tables 4 and 5 show the total daily cost and daily net income, respectively in a farm with 5 milking cows. Provided that the average daily milk yield (L) per cow in each treatment was the same as in this study, T1 (Control) had the lowest daily cost (Table 4). Treatment 1 was lower than T2 and T3 by PhP 10.02 and PhP 20.10, respectively. However, when the daily net income was considered, T2 generated an income greater than T1 by PhP 207.73 (Table 5). This translates to a higher income for the dairy farmer.

Table 1. Average daily milk yield of dairy buffaloes supplemented with activated yeast (*Saccharomyces cerevisiae*) solution (AYS)

TREATMENT (given twice daily)	N[1]	Initial Milk Yield (L)[2, ns]	Final Milk Yield (L)[3, **]	Standard Deviation
T1- Customized feeds (Control)	9	6.32	5.28[b]	1.06
T2- Customized feeds + 0.5L AYS	9	6.35	5.95[a]	1.06
T3- Customized feeds + 1L AYS	9	6.38	5.97[a]	1.07

ns= *P* value 0.9427, **=*P* value 0.0039, [1]=No. of experimental animals, [2]=Average milk yield a day before the start of the experiment, [3]=Average daily milk yield for eight weeks. Means of the same superscript are not significant from each other

Table 2. Daily cost of feeding for each dietary treatment per animal using customized feeds and activated yeast (*Saccharomyces cerevisiae*) solution (AYS)

Treatment (given twice daily)	Consumed per day[1]	Price per Kilogram or Liter (PhP)[2]	Cost of feeding per day[3]	Total (PhP)[4]
T1- Customized feeds (Control)	6 kg	19.75	118.50	118.50
T2- Customized feeds + 0.5L AYS	6 kg	19.75	118.50	120.50
	1L	2.00	2.00	
T3- Customized feeds + 1L AYS	6 kg	19.75	118.50	122.50
	2 L	2.00	4.00	

[2]=Prevailing market price in 2018, [3]=Product of multiplying item 1 with item 2, [4]=Total cost of feeding per day

Table 3. Cost per liter of milk produced per animal for each dietary treatment using customized feeds and activated yeast (*Saccharomyces cerevisiae*) solution (AYS)

Treatment (given twice daily)	Cost of feeding per day (PhP)[1]	Average daily milk yield (L)[2]	Cost per liter of milk (PhP)[3]
T1- Customized feeds (Control)	118.50	5.28	22.44
T2- Customized feeds + 0.5L AYS	120.50	5.95	20.25
T3- Customized feeds + 1L AYS	122.50	5.97	20.52

[1]=Taken from item 4 of Table 2, [2]=Taken from item 3 of Table 1, [3]=Product of multiplying item 1 with item 2

Table 4. Estimated daily cost per treatment in a farm with five (5) milking cows fed with customized feeds and supplemented with activated yeast (*Saccharomyces cerevisiae*) solution (AYS)

Treatment (given twice daily)	Average daily milk yield (L)[1]	Number of milking cows[2]	Total milk volume (L)[3]	Cost per liter produced (PhP)[4]	Total daily cost (PhP)[5]
T1- Customized feeds (Control)	5.28	5	26.40	22.44	592.416
T2- Customized feeds + 0.5L AYS	5.95	5	29.75	20.25	602.44
T3- Customized feeds + 1L AYS	5.97	5	29.85	20.52	612.52

[1]=Taken from item 3 of Table 1, [2]=Hypothetical no. of cows in a farm, [3]=Product of item 1 multiplied by item 2, [4]=Taken from item 3 of Table 3, [5]=Product of multiplying item 3 with item 4

Table 5. Estimated daily net income per treatment in a farm with five (5) milking cows fed with customized feeds and supplemented with activated yeast (*Saccharomyces cerevisiae*) solution (AYS)

Treatment (given twice daily)	Average daily milk yield (L)[1]	No. of milking cows[2]	Total milk volume (L)[3]	Price per liter of milk (PhP)[4]	Gross income (PhP)[5]	Total daily cost (PhP)[6]	Net income (PhP)[7]
T1- Customized feeds (Control)	5.28	5	26.40	65.00	1,716.00	592.42	1,123.58
T2- Customized feeds + 0.5L AYS	5.95	5	29.75	65.00	1,933.75	602.44	1,331.31
T3- Customized feeds + 1L AYS	5.97	5	29.85	65.00	1,940.25	612.52	1,327.73

[1]= Taken from item 3 of Table 1, [2] = Hypothetical number of cows in farm, [3]= Product of multiplying item 1 with item 2, [4]= Prevailing market price of raw milk in the province of Bohol, [5]= Product of multiplying item 3 with item 4, [6]=Taken from item 5 of Table 4, [7]= Difference of subtracting item 6 from item 5

Effect of yeast-fermented cassava pulp (YFCP) on milk yield performance

After eight (8) weeks of data collection, results showed that the average daily milk yield of T2 and T3 buffaloes were significantly greater than T1 (control) buffaloes by 0.64 L and 0.68 L, respectively (P = 0.0320) (Table 6). However, the results of post-hoc test (LSD) revealed no significant difference between the milk yields of T2 and T3. The addition of yeast as fermentative agent in cassava pulp has numerous beneficial effects in the rumen microbial ecosystem resulting to positive effects in milk production. In the study of Sommai et al. (2020), YFCP increased the population of cellulolytic, amylolytic and proteolytic bacteria. These bacteria are important for the digestion of cellulose and synthesis of protein. Feeding of YFCP could also remarkably enhance Organic Matter (OM) and Crude Protein (CP) resulting to increased dry matter intake (Sommai et al. 2020) Moreover, the use of YFCP at high level could result in highest nitrogen-balance and nitrogen-retention absorption (Sommai et al. 2020). Chuelong et al. (2011) also reported that YFCP could improve ruminal fermentation efficiency as manifested in cross-bred native cattle of Thailand. Moreover, Polyorach et al. (2013) revealed that yeast-fermented cassava chip could contain high protein up to 32.5%. Chuelong et al. (2011) also added that cassava pulp contains high soluble fractions of starch and protein nitrogen and can be added in diets to increase utilization of ruminal ammonia-N for microbial protein synthesis. All these mechanisms contributed significantly to high milk production in dairy animals.

Table 7 shows the daily total cost of feeding per animal using the three dietary treatments. It was shown that based on the prevailing price in 2018, T2 was cheaper than T1 (control) by PhP 42.64 and cheaper than T3 by PhP 14.80. Taking into consideration the cost of feeding to produce one (1) liter of milk per animal, T2 had the lowest cost at PhP 16.24 (Table 8). It was cheaper than T1 and T3 by PhP 10.15 and PhP 2.04, respectively.

To appreciate more the economic benefits of feeding YFCP, Tables 9 and 10 show the total daily cost and daily net income, respectively in a farm with 5 milking cows. Provided that the average daily milk yield (L) per cow in each treatment was the same as in this study, T2 had the lowest daily cost (Table 9). Treatment 2 was lower than T1 (Control) and T3 by PhP 213.46 and PhP 74.17, respectively. If the daily net income was considered, T2 generated an income greater than T1 by PhP 421.46 (Table 10). This translates to a much higher income for the dairy farmers.

Table 6. Average daily milk yield of dairy buffaloes fed ration with commercial feeds and yeast-fermented cassava pulp (YFCP)

Treatment	N[1]	Initial Milk Yield (L)[2, ns]	Mean milk yield (L)[3, *]	Standard Deviation
T1- Commercial Feeds (Control)	12	6.02	5.23[b]	1.40
T2 – YFCP	12	6.79	5.87[a]	1.88
T3 – YFCP+AYS	12	6.83	5.91[a]	1.51

Ns= *P* value 0.239, [*]= *P* value 0.0320, [2]= Average milk yield a day before the start of the experiment, [3]= Average daily milk yield for eight weeks, means of the same superscript are not significant from each other, AYS = activated yeast (*Saccharomyces cerevisiae*) solution

Table 7. Daily cost of feeding for each dietary treatment per animal using commercial feeds and yeast-fermented cassava pulp (YFCP)

Treatment	Consumed per day[1]	Price per Kilogram or Liter (PhP)[2]	Cost of feeding per day[3]	Total (PhP)[4]
T1- Commercial Feeds (Control)	6 kg	23.00	138.00	138.00
T2- YFCP	8 kg	11.92	95.36	95.36
T3- YFCP + AYS	8 kg	11.92	95.36	110.16
	2 L	7.40	14.8	

[2]= Prevailing market price in 2018, [3]= Product of multiplying item 1 with item 2, [4]= Total cost of feeding per day, AYS = activated yeast (*Saccharomyces cerevisiae*) solution

Table 8. Cost per liter of milk produced per animal for each dietary treatment using commercial feeds and yeast-fermented cassava pulp (YFCP)

Treatment	Cost of feeding per day (PhP)[1]	Average daily milk yield (L)[2]	Cost per liter of milk (PhP)[3]
T1- Commercial Feeds (Control)	138.00	5.23	26.39
T2- YFCP	95.36	5.87	16.24
T3- YFCP + AYS	110.16	5.91	18.64

[1]= Taken from item 4 of Table 7, [2]= Taken from item 3 of Table 6, [3]= Product of multiplying item 1 with item 2.

Table 9. Estimated daily cost per treatment in a farm with five (5) milking cows fed with commercial feeds and yeast-fermented cassava pulp (YFCP)

Treatment	Average daily milk yield (L)[1]	No. of milking cows[2]	Total milk volume (L)[3]	Cost per liter produced (PhP)[4]	Total daily cost (PhP)[5]
T1- Commercial Feeds (Control)	5.23	5	26.15	26.39	690.10
T2- YFCP	5.87	5	29.35	16.24	476.64
T3- YFCP + AYS	5.91	5	29.55	18.64	550.81

[1]= Taken from item 3 of Table 6, [2]= Hypothetical no. of cows in a farm, [3]= Product of item 1 multiplied by item 2, [4]= Taken from item 3 of Table 8, [5]= Product of multiplying item 3 with item 4

Table 10. Estimated daily net income per treatment in a farm with five (5) milking cows fed with commercial feeds and yeast-fermented cassava pulp (YFCP)

Treatment	Average daily milk yield (L)[1]	Number of milking cows[2]	Total milk volume (L)[3]	Price per liter of milk (PhP)[4]	Gross income (PhP)[5]	Total daily cost (PhP)[6]	Net income (PhP)[7]
T1- Commercial Feeds (Control)	5.23	5	26.15	65.00	1,699.75	690.10	1,009.65
T2- YFCP	5.87	5	29.35	65.00	1,907.75	476.64	1,431.11
T3- YFCP + AYS	5.91	5	29.55	65.00	1,920.75	550.81	1,369.94

[1]Taken from item 3 of Table 6, [2]= Hypothetical no. of cows in a farm, [3]= Product of item 1 multiplied by item 2, [4]= Taken from item 3 of Table 9, [5]= Product of multiplying item 3 with item 4

CONCLUSION

Based on the results of the study, it is recommended to supplement milking buffaloes with AYS at a rate of 0.5 L twice a day to increase average daily milk yield by at least 0.67L per cow and improve feed cost efficiency. In areas with abundant cassava pulp, feeding milking dairy buffaloes with YFCP is recommended also to increase feed resource, increase average daily milk yield by at least 0.64L per cow and improve feed cost-efficiency thereby increasing significantly the dairy farmer's income.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to the Philippine Carabao Center National Headquarters for funding the study. Thanks are likewise due to Arlene Joy S. Bacsan, Zeila Czyra R. Yenogacio, Marjorie Avellana and Marjanie Mae B. Decinilla for collecting the data and preparing the reports during the in-house reviews. Recognition is also given to Dr. Gundolino P. Bajenting, Karen S. Ciroy and milkers of the Institutional Farm for patiently giving the experimental diets and openly providing the needed data. The authors are also grateful to Dr. Maria Dinah R. Loculan, Center Director of PCC-USF for extending her steadfast support to this study.

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