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Research Article

# Supplementation of *Saccharomyces cerevisiae* and *Sapindus rarak* in Diet Based of Oil Palm Frond (OPF) on Nutrient Digestibility and Daily Weight Gain of Goat

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## Abstract

This experiment was to study the effect of adding *Saccharomyces cerevisiae* and *Sapindus rarak* in diet Oil Palm Frond (OPF) based of nutrients digestibility and body weight gain of goats. Experimental desiegn used randomized blok design, with 4 treatments and 4 groups as replications. This experiment used six teen ettawa goats (40±8.5 kg liveweight). The four treatments were (A) native grass+concentrate (B), OPF (previously treated with 6% urea)+concentrate, (C) Diet B+1% *Saccharomyces cerevisae* and (D) Diet C+4% *Sapindus rarak*. The animals were adjusted to their treatments over a 2 week preliminary period which was followed by an 8 week experimental period. Feed intake was determined daily and live weight was measured every two week. Digestibility was measured by total faecal collection over 6 consecutive days on last week of experiment period. The results showed that the dry matter digestibility of treatment B (50.74%) were significantly lower than treatments A, C and D respectively (67.37, 62.38 and 65.71%) and supplementation of *Saccharomyces cerevisiae* was able to improve nutrient digestibility and body weight gain of goat, but still low compared to control (A). Addition of 4% *Sapindus rarak* in treatment D (123 g day$^{-1}$) was able to provide digestibility and body weight gain similar to the control ration (132 g day$^{-1}$). It can be concluded that the use of OPD as a substitute for grass in goat diets would give the same results with the grass when added 1% *Saccharomyces cerevisiae* and 4% *Sapindus rarak*.

**Key words:** Oil palm frond, *Sapindus rarak*, *Sacharomyces cerevisiae*, goat, digestibility, weight gain, ammoniated, defaunation

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**Competing Interest:** The authors have declared that no competing interest exists.

**Data Availability:** All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Indonesia has a extensive oil palm plantation till now. According to Pertanian[1] Indonesia has 8,908,000 ha of oil palm plantations in 2011 and in 2014 has reached 10,210,892 ha. The plantation and industry of palm oil produced oil palm byproduct such as Oil Palm Fronds (OPF), Palm Kernel Cake (PKC), Palm Oil Sludge (POS)[2]. Oil palm fronds could be used as replace grasses in ration of ruminant in Indonesia. Based on study of Simanuhuruk *et al*.[3] production of palm frond oil can reach 40-50 fresh frond/tree/year with weights frond dry weight of 4.5 kg per frond. In one hectare of oil palm is expected to produce 6400-7500 fresh frond per year.

Oil Palm Fronds could be used as a source of fiber feed or as a component of ration for ruminants but it is contain low protein and high fiber content[4,5]. To maximize the utilization of available this feed resources as ruminant feed is needed the strategy to improve it's quality through processing by treated with 3% urea (ammoniation technique) as suggested of Zain *et al*.[5]. In addition to improving its use in rations also necessary effort to improved the microbial population in the rumen by adding rumen microbial growth factor.

Rumen microbial growth factor that can be used to increased rumen microbial population like as a defaunating agent that can reduced population of rumen protozoa as discussed by Zain *et al*.[6] and direct feed microbial to got an optimum condition for rumen bacterial growth as discussed elsewhere[7,8]. Number of protozoa in rumen must be reduced when using low quality feed such as oil palm fronds because protozoa would predation and digestion of rumen bacteria. Rumen protozoa can reduced by used the *Sapindus rarak* fruit pericarp extract[9]. Direct fed microbial such as *Saccharomyces cerevisiae* supplementation on ruminant productive performance have been widely studied, but results are inconsistent. Cellulolytic activity of fibrolytic bacteria in the rumen fibrolytic bacteria in the rumen could stimulated with supplemented with yeast based study[10-13] improve feed intake and production of animal[14,8]. Therefore, the objective of our experiment was to determine whether supplementation of direct fed microbial like as *Saccharomyces cerevisiae* and defaunating agent (*Sapindus rarak*) could increase the nutrient digestibility and goat performance that feeding oil palm fronds ammoniated.

## MATERIALS AND METHODS

Sixteen male Ettawa goats (40+4.5 kg SEM) live weight equipped were randomly distributed in a 4×4 Completely Randomized Design (CRD). The four treatments were (A) native grass+concentrate (B), OPF (previously treated with 6% urea)+concentrate, (C) Diet B+1% *S. cerevisae* and (D) Diet C+4% *Sapindus rarak*. Basal diet contained (dry basis) 50% OPF and 50% concentrate. The composition of feeds including concentrate is given in Table 1. The study was divided into two phases i.e., preliminary period and experiment period (data collection phase). In preliminary period, preparation of ration complete feed and male goat as material of research had done. Adaptation on farm environment and feed was done in two weeks and was continued by observation and data collection in 8 weeks.

Table 1: Composition of feedstuffs to formulate complete feed in each treatment

| | Diet (DM %) | | | |
|---|---|---|---|---|
| Item | A | B | C | D |
| Oil palm frond ammoniated | - | 50.0 | 50.0 | 50.0 |
| Grass | 50.0 | - | - | - |
| Rice brand | 28.0 | 28.0 | 28.0 | 28.0 |
| Corn | 10.0 | 10.0 | 10.0 | 10.0 |
| Coconute cake | 11.0 | 11.0 | 11.0 | 11.0 |
| Salt | 0.5 | 0.5 | 00.5 | 00.5 |
| Mineral | 0.5 | 0.5 | 00.5 | 0.5 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |
| Supplementation | | | | |
| *Saccharomyces cerevisiae* | - | - | 1 | 1 |
| *Sapindus rarak* | - | - | | 4 |
| **Nutrition (%)** | | | | |
| Protein | 12.66 | 12.01 | 12.01 | 12.01 |
| TDN | 64.73 | 63.83 | 63.83 | 63.83 |
| Lemak | 3.60 | 3.95 | 3.95 | 3.95 |
| BETN | 49.91 | 48.66 | 48.66 | 48.66 |
| NDF | 43.14 | 46.75 | 46.75 | 46.75 |
| ADF | 35.24 | 37.55 | 37.55 | 37.55 |

TDN: Total digestible nutrients, NDF: Neutral Detergent Fiber and ADF: Acid Detergent Fiber

Digestibility trials conducted using four animals for each treatment which were separated in individual pens. Goats were fed *ad-libitum* during the preliminary phase (15 days) and then restricted during the collection phase (last 6 days) at 90% of the intake feed that was offered at 7:00 and 16:00 h last 15 days of collection period. Animals were equipped with bags fitted to the animals with harness for total collection. During the collection period accurate records were kept for individual feed intake. Live weight was measured every two week. Total fecal excretion was collected once daily and 10% representative samples were dried at 60°C over night and kept in sealed bags until analysis. Feed and fecal were ground to pass through a 1 mm screen and composited. Dry matter, organic matter and nitrogen were analyzed by standard methods[15]. Neutral Detergent Fiber (NDF), Acids Detergent Fiber (ADF), cellulose were determined by procedures outlined by Goering and Van Soest[16].

**Preparation of *Sapindus rarak* and *Saccharomyces cerevisiae*:** Fruit of *Sapindus rarak* were dried in an oven at 60°C until they had of 90% dry matter constant. The whole fruits (including seed) were ground immediately after drying. *Saccharomyces cerevisiae* was obtained in Biotechnology Laboratory of Gajah Mada University, Yogyakarta Indonesia collection, strain Meyen ex Hansen) and it is contained 4 x $10^8$ live organisms/g, in medium on which it was grown. The composition of *Saccharomyces cerevisiae* medium were 4 g glucose, 2 g Yeast Extract Broth (YEB) and 3 g jelly powder. Mixed medium with 200 mL aquadest and inclusion on erlenmeyer glass. Autoclave on 121°C temperature, 1 atm pressure during 15 min. After 15 min remove the medium from autoclave and included in petri disk. Inoculation *Saccharomyces cerevisiae* product 1 mL in 99 mL aquadest. Prepared eight test tube for inoculated. Given test tube with code, 1 till 8. Filled test tube with 9 mL aquadest. After that, included 1 mL *Saccharomyces cerevisiae* on test tube 1, then took 1 mL from test tube 1 and removed in test tube 2, conducted it same treatment till test tube 8. Removed 1 mL from test tube 8 in petri disk that filled medium and let stand during 24 h. After 24 h, the total colonies of *Saccharomyces cerevisiae* counted in counting chamber.

**Statistical analysis:** Data were analyzed using the General Linear Model procedure in Statistical Analysis Software (SAS, version).

## RESULTS AND DISCUSSION

**Digestibility of nutrient:** The result of effects addition of *S. cerevisiae* and *Sapindus rarak* on nutrient digestibility of ration based on oil palm frond ammoniated of goat are presented in Table 2. Effects of treatments were significant ($p<0.05$) increased dry matter, organic matter, NDF, ADF, cellulose and hemicellulose digestibility. Dry matter and organic matter digestibility in A, B, C and D treatments were 67.37, 50.74, 62.38 and 65.71% and organic matter digestibility were 70.20, 55.90, 66.33 and 67.64%, respectively. These result indicated that combination and *Saccharomyces cerevisiae* and *Sapindus rarak* in treatment D had higher dry matter and organic matter digestibility compared with treatment B and C.

This increased is likely due to the role of *Saccharomyces cerevisiae* can increased rumen microbial growth. More over increased dry matter digestibility and organic matter this may have indicated increased activity of rumen bacteria. The increasing activity of rumen microbial can level up degrading activity of organic matter into simple soluble compounds and it will lead to the increasing of organic substance absorption. This is in line with the study conducted by Paryad and Rashidi[17] who stated that the nutrient digestibility of goat and sheep rations supplemented with yeast was significantly increased compared with controls. *Saccharomyces cerevisiae* also had the capability to reduced oxygen so, the rumen environment become conducive for growth rumen bacteria especially cellulolytic bacteria as reported by Wallace[18]. Supplementation of *Sapindus rarak* would suppression of protozoa and may enhanced the flow of microbial protein from the rumen, increased the efficiency of feed utilization and improved the nutrition of the animal, provided that the loss of protozoa does not impair the fiber breakdown as reported by Newbold *et al.*[19].

Table 2: Digestibility nutreint of goat with experimental diet

| | Diet | | | |
|---|---|---|---|---|
| Items | A | B | C | D |
| Dry matter digestibility (%) | 67.37$^{a}$ | 50.74$^{d}$ | 62.38$^{c}$ | 65.71$^{b}$ |
| Organic matter digestibility (%) | 70.20$^{a}$ | 55.90$^{c}$ | 66.33$^{b}$ | 67.64$^{b}$ |
| NDF digestibility (%) | 60.22$^{a}$ | 47.90$^{c}$ | 54.34$^{b}$ | 60.21$^{a}$ |
| ADF digestibility (%) | 53.12$^{a}$ | 35.89$^{d}$ | 42.74$^{c}$ | 49.52$^{b}$ |
| Cellulosa digestibility | 64.43$^{a}$ | 43.84$^{c}$ | 53.97$^{b}$ | 59.31$^{ab}$ |
| Hemicellulosa digestibility | 64.79$^{a}$ | 50.66$^{c}$ | 57.70$^{b}$ | 65.55$^{ab}$ |

Means in the same row with different in their superscript differ ($p<0.05$)

In this study, NDF, ADF and cellulose digestibility obtained was also significantly affected by *Saccharomyces cerevisiae* and *Sapindus rarak* supplementation. This is presumably because S*accharomyces cerevisiae* that containing 4x$10^8$ live microorganism/g have ability to degraded the fiber. NDF, ADF and cellulose that have potential as a source of energy for ruminants because they were fiber from the carbohydrate fraction. Supplementation of *Saccharomyces cerevisiae* and *Sapindus rarak* can increased activity of rumen microbial growth, then cases increased digestibility of NDF, ADF and cellulose. According to Fadel Elseed and Abusamra[20], *Saccharomyces cerevisiae* could increased OM plus NDF digestibility compared good quality forages with control diet. Furthermore, supplementation single Direct Fed Microbial (DFM) of *Saccharomyces cerevisiae* was suitable to be used single or in combination with *Aspergillus oryzae* or *Baccillus amilolyquifaciens* could increased fermentability and degradability of ammoniated palm frond[21]. Some researchers[22,23], have been reported that treatment with some yeast cultures increased the number of total and cellulolytic bacteria in the rumen and in some cases increased cellulose degradation. The result of Miller-Webster *et al.*[22], showed that *Aspergillus oryzae* fermentation extract and *Saccharomyces cerevisiae* culture stimulated fiber digestion by ruminal

Table 3: Feed intake, average daily gain of goat with experimental diet

| | Diet | | | |
|---|---|---|---|---|
| Items | A | B | C | D |
| Dry matter intake (g day$^{-1}$) | 993$^{a}$ | 734$^{b}$ | 828$^{ab}$ | 906$^{a}$ |
| Organic matter intake (g day$^{-1}$) | 735$^{a}$ | 556$^{b}$ | 679$^{ab}$ | 720$^{a}$ |
| Average daily gain (g day$^{-1}$) | 132$^{a}$ | 80$^{b}$ | 108$^{c}$ | 123$^{a}$ |

Means in the same row with different in their superscript differ (p<0.05)

microorganisms. Increased digestibility of NDF, ADF and cellulose with supplementation *Saccharomyces cerevisiae* indicated that supplementation could promote rumen cellulolytic bacteria[12-24]. Increasing the number of rumen cellulolytic caused *Saccharomyces cerevisiae* provided essential metabolite for its growth. The relatively stable rumen pH for growth of rumen microbes, especially cellulolytic bacteria causing growth to be better so the fiber fraction digestibility also increased. It is also reported by several researchers[22,20,7].

**Feed intake and daily gain:** Feed intake and daily weight gain of this treatments are shown in Table 3. Dry matter, organic matter intake and average daily gain significantly affected of the treatments (p<0.05). This Table showed that supplementation of *Saccharomyces cerevisiae* can increased of nutrient intake and daily weight gain of goat when compared without *Saccharomyces cerevisiae* supplementation but still lower compared control diet. Supplementation of *Sapindus rarak* in treatment D could increased the nutrient intake, the same as with control diet and could improved the animal performance.

The positive effect of *Saccharomyces cerevisiae* in increasing nutrient intake and average daily gain of goat may be attributed to the increase of numbers of rumen total viable bacteria and cellulolytic bacteria[25]. Moreover, the stabilization of rumen environment could to be the reason for increased of numbers of rumen bacteria also may be related to pH modulation via reductions in lactic acid concentration[26].

Supplementation *Sapindus rarak* in D treatment gave the best result compared with other treatment. This is likely due to the role of *Sapindus rarak* can release protozoa, thus release of protozoa can increase activity of rumen bacteria because existence of protozoa undesirable when goat received that high fiber feed. Exsistent of protozoa tend to prey rumen bacteria to viability of protozoa[9]. The daily DMI were ranged at 734-993 g/head/day. The lowest OMI was in the B. The high feed consumption was correlated with the high animal productivity and was influenced of digestibility. High nutrient digestibility will increased the nutrient intake.

Average Daily Gain (ADG) of goat was lower in this study than the study in indigenous rams fed complete feed by Purbowati *et al.*[27] who reported the average daily gain were 145.22-164.98 g. This might be caused by the different kinds and feedstuffs composition compose the complete feed. The main factor affected animal ADG is total nutrients consumed and biological value of feed. Feed consumption showed total energy and nutrient intake to promote the growth and animal production, so that if feed consumption is high, the ADG will also high.

## CONCLUSION

Oil palm fronds can be used to replace the field grass in formulation of complete feed for goat if supplemented with 1% *Saccharomyces cerevisiae* and 4% *Sapindus rarak*.

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