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Utilization of water mimosa (*Neptunia oleracea*) leaf meal in concentrate feed to improve the growth of Kalimantan swamp buffalo calves

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ABSTRACT

Swamp buffalo on Kalimantan island is reared under an extensive production system. Minimum farmer input and decreasing swamp grass availability during the wet season lead to lower buffalo morphometrics, lower reproductive performances, and a higher calf mortality rate. This participatory study was conducted to evaluate the calf's performance after receiving a concentrate feed formulated using water mimosa (*Neptunia oleracea*) leaf meal as a protein source. Results of the study showed that water mimosa leaf meal has high crude protein content (>30%). After 4 months of observation, feeding concentrate feed formulated with water mimosa leaf meal as a protein source improved the growth of swamp buffalo calves. The calves in concentrate feed group showed body weight gain of 14.84 kg/month, growths of chest girth 13.6 cm, and height at wither 5.6 cm those improved compared to those in the group that did not offer concentrate feed that had the growths in chest girth 9.2 cm and height at wither 5.2 cm. This study provides valuable insights into the potential of using water mimosa leaf meals as a protein source for concentrate feed, which can enhance the growth of buffalo calves while resolving the issue of water mimosa invasion in the swamp area.

Keywords: Buffalo calf, Concentrate feed, Leguminous leaf meal, Swamp buffalo, Water mimosa

1. Introduction

The majority of the total world buffalo population is distributed in Asia, holding around 97% of the available stock, with swamp buffaloes found only in the Asia continent (Deb et al 2016). Swamp buffalo (*Bubalus bubalis carabenensis*) is an important agricultural animal for smallholders in Southeast Asia, with its primary purpose being land cultivation. However, as farm mechanization has increased, the value of swamp buffalo has declined, shifting their purpose from draft power to meat and milk production (Pineda et al 2021). Despite this shift, swamp buffaloes are still raised by smallholder farmers in Southeast Asia for their other important roles, such as for family saving (Rohaeni et al 2019).

Swamp buffaloes are an efficient converter of poor-quality forages into high-quality milk and meat. However, the production and population of swamp buffalo have declined in recent decades due to some reasons, especially due to farm mechanization, disease, and poor management in the extensive production system (Sumantri et al 2022). To address this issue, studies have been conducted to

improve buffalo production systems such as the adoption of reproductive technologies, feed technology and breeding (Deb et al 2016; Sumantri et al 2022).

The improvement of the buffalo traditional production system was also promoted in South Kalimantan, Indonesia, where the Kalimantan buffalo breed was raised traditionally in a swamp area locally known as *Kalang system* (Widi et al 2021). One approach to improving *Kalang* system is by providing sufficient feed to the calves when the buffalo herd is left to graze. However, swamp area conversion into oil palm plantation and settlement areas has reduced the availability of swamp grass for buffalo feeding (Sumantri et al 2022). In addition, the growth of water mimosa (*Neptunia oleracea*) leads to the covering of the swamp surface, thus reducing the growth of grasses.

Water mimosa is an invasive legume that is categorised as a weed (Queensland Government 2020). Previous research showed water mimosa has a high protein content, reaching 32% of crude protein (Saupi et al 2015). Our previous observation and farmer report revealed that water mimosa shoots are consumed by buffaloes during periods of grass shortage. Therefore, water mimosa is potentially used as a feed and protein source. This study was conducted to evaluate the utilisation of water mimosa leaf meal as a protein source in concentrate feed for buffalo calves.

2. Materials and Methods

Materials

The study was conducted in the Hulu Sungai Selatan District, South Kalimantan Province, Indonesia. Previously, water mimosa samples were collected and chemically analysed to obtain nutrient content data (the contents of dry matter, organic matter, crude protein, and crude fiber) according to AOAC method (AOAC 2000). Data of dry matter and crude protein percentages were used to formulate the concentrate feed. Concentrate feed was made from locally available feed ingredients, except for skim milk. The concentrate feed formula is shown in Table 1 below.

Table 1. Concentrate feed formula and gross nutrients content

	Nutrient Content		
Ingredient	Crude Protein (%)	ME (Mcal/kg)	% Formula
Rice brand	12.0	3.99	35
Water mimosa leaf meal	35.0	2.51	15
Sweet potato flour	3.5	2.87	15
Skim milk	25.0	3.28	25
Molasses	4.2	2.28	5
Mineral mix	0.0	0.00	5
Total	16.2	2.72	100


(a)

(b)

Photo 1. (a) Water mimosa covering swamp area; (b) Concentrate feed making by smallholder farmer

Methods

Two buffalo farmer groups were participating in this study. One group was not in favour of using concentrate feed (No Concentrate Feed Group/NCF) and the other group was in favour of using the concentrate feed (Concentrate Group/CF). In each group, 5 lactating buffalo calves were consisting of 2 male and 3 female calves. In the CF group, the concentrate feed was offered as much as 2 kg per head per day for 4 months of the study. In addition, swamp grass was offered *ad libitum* to both groups.

The observed variables were weight gain and body measurements (growths in chest girth and height of wither). However, the NCF group was not willing to weigh the buffalo calves, so weight gain data was not available for the NCF group. Data were collected once a month during the 4 months of the study. Data were statistically and descriptively analysed.

3. Results and Discussion

Water mimosa nutrient contents

Result of laboratory analysed indicated the water mimosa contains high crude protein contents, especially from the leaves parts. According to Topps (1992) legumes had a medium to high crude protein (CP) content, range 12.0-29.8%, that makes them a valuable source of protein for livestock in the tropics. However, some legume species might have CP more than 30%, such as *Indigofera zollingeriana* which is containing CP between 29-34% (Antari et al 2022). Variation in CP content of legume is probably due to the stage of growth which sampling time took places and the legume parts harvested, i.e. leaves and shoots rather than woody branches. According to Saupi et al (2015), shoots of water mimosa was containing dry matter 11.3-13.7%; ash 10.5-10.7%; crude protein 30.1-32.3%; crude fiber 23.0-26.6%; and crude fat 2.5-4.4%.

Table 2. Nutrient content of water mimosa (*N. oleracea*)

	Nutrients (%)				
Plant Parts	Dry Matter	Ash	Crude Protein	Crude Fiber	Crude Fat
Young leaf	23.29	8.13	34.96	12.35	2.24
Old leaf	24.73	8.26	38.95	13.06	2.60
All plant	23.05	8.75	25.95	26.29	1.05

Buffalo calf weight gain

As mentioned above, weight gain data were only available from the CF group. The weight gain of buffalo calves fed the concentrate is presented in Table 3 below. Table 2 shows the buffalo calf's weight gain reach 14 kg/month in the CF group. Unfortunately, there was no data on weight gain from the No Concentrate Feed group (NCF). Information on the growth of pre-weaning swamp buffalo under an extensive production system is scarce in proportion to river buffalo or calves under an intensive production system.

Table 3. Body weight gain of calves (kg/month) received concentrate feed containing water mimosa

Group	Body Weight Gain		
	Male	Female	All
No Concentrate Feed	NA	NA	NA
Concentrate Feed	12.10 ± 2.9	14.84 ± 7.0	14.84 ± 5.7

NA: Data is not available

Bharti et al (2022) observed the growth of Murrah calves buffalo and showed the suckling calves grew 15.4 kg/month that significantly higher than calves weaned at 45th of age and receiving calf starter. Buffalo calves in intensive systems are reported to grow significantly faster than those in extensive production systems, which indicates that proper nutrition is a key factor in the growth and development of swamp buffalo calves (Alvarez et al 2008).

Our previous observation on buffalo calves under *Kalang* production systems indicated poor body condition scores and health status due to minimal farmer input and decreasing availability of swamp grass during the wet season. This often leads to higher calf mortality rates (Widi et al 2021). Therefore, it is crucial to find ways to improve the growth and survival rate of swamp buffalo calves while minimizing the input required from farmers. This participatory study suggests that feeding

concentrate feed formulated with water mimosa leaf meals as a protein source can improve the growth of swamp buffalo calves while also resolving the issue of water mimosa invasion in swamps.

Body measurements

The results showed that calves that received concentrate feed grew higher than the calves that did not receive concentrate feed (Table 4). This study also revealed that female buffalo calves grew faster than male. The water mimosa (*Neptunia oleracea*) is rich in nutrients like protein, calcium, phosphorus, beta-carotene, vitamin A, vitamin C, fibre, and niacin, all of which are vital for body health (Ainisyuhaida et al 2014). The higher growth in chest girth and height at wither in the CF group indicated calves in this group had better nutrient intake than the NCF group.

Table 4. Growth of body measurements of buffalo calves received concentrate feed containing water mimosa

	Chest Girth			Height at Wither		
Group	Male	Female	All	Male	Female	All
No Concentrate Feed	9.5±0.71	9.0±2.65	9.2±1.92	4.5±0.71	5.7±1.15	5.2±1.10
Concentrate Feed	12.0±4.24	14.7±4.62	13.6±4.16	5.0±1.41	6.0±2.00	5.6±1.67

In the traditional production system, buffalo calves will remain in the pen when the herd is released for grazing during the day. This is because the calves are not able to swim for long in the swamp when searching for grass. When left in the pen, the calves only get a small amount of grass with no feed concentrate or calf starter. This results in high calves mortality of up to 40% (Widi et al 2021) and a decline in the physical size of Kalimantan buffalo (Sumantri et al 2022)

The source of dietary protein affects the performance of buffalo calves. Indira et al (2009) showed that calves receiving *Azolla pinnata* as a protein source grew faster and more efficiently than those receiving N from grass, rice straw and concentrate mix. Another study by Sherief and Ekramy (2021) showed that the use of moringa leaf meal 15-20% replacing soybean meal in concentrate feed significantly increased rumen digestibility and fermentation kinetics thereby increasing feed consumption, daily weight gain and feed efficiency of 8-9-month-old buffalo calves.

However, the level of water mimosa inclusion must be carefully considered in future studies to determine the optimal level of inclusion that can provide maximum benefits without any negative impact on buffalo calf growth and health. Water mimosa can uptake and accumulate heavy metals, i.e. Pb, Cu and Cd, in their tissue parts thus bringing a concern for human consumption (Wahab et al 2014). In addition, water mimosa is high in alkaloids, saponins and tannins, which can be toxic to microorganisms (Naqinie et al 2021).

4. Conclusions

In conclusion, the use of water mimosa meal as a protein source in concentrate feed showed positive effects on the weight gain and growth of swamp buffalo calves, which could contribute to improving the productivity of swamp buffalo farming systems. Further research is needed to optimize the formulation of concentrate feed incorporating water mimosa leaf meals and to investigate the potential long-term effects on growth and health. This study provides valuable insights into the potential use of unconventional protein sources for improving the productivity of swamp buffalo calves and a sustainable way to resolve the water mimosa invasion in swamp areas.

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Conflict of Interest

There is no conflict of interest including any financial, personal or other relationships with other people or organizations considering to this article

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