

# Sampling and Botanical Identification of Forages for Goat as Project-Based Learning Model in the Feed Quality

## Control Subject

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### ABSTRACT

Forages and green fodder are the primary feed source for ruminants of goat, cattle, buffaloes in West Sumatra. Forages compose various wild plant species collected from different lands, but the livestock will select and consume the palatable plant types. The objective of the present study was to offer the animal nutrition students project-based learning (PjBL) to gain their experience in the diversity of plant species typically provided and consumed by goats raised by traditional farms. Enrolled students visited and interviewed goat farm owners, then collected forage samples for botanical identification and laboratory analysis. Data were analyzed and presented in a scientific paper. There were about 45-46 kinds of vegetation used for feeding goats in Payakumbuh. They composed about 31-43% grasses, 37-42% broadleaves, 9% legumes, 2-11% tuber leaves, and 7-9% tree leaves. Farm owners offered edible and nutritious plant species according to the preference of their livestock. There was a wide variety of plant species utilized as green fodder feed for goats in Payakumbuh. In conclusion, the students experienced that farm owners offered palatable and nutritious plant species according to the preference of their livestock

**Keywords:** *forage sampling, goat nutrition, project-based learning, wild forages*

### 1. INTRODUCTION

The subject of PT 267. Feed Quality Control is one of the applied courses in Feed Science and Technology. This subject is an elective course involving 6-7 lecturers, offered to students starting in the fourth semester. Course subject covers knowledge and skills regarding feed quality criteria, methods of sampling, sample preparation, and analysis; factors affecting feed; feed quality standards and regulations for feed and quality control [1]. The contribution of this course to the competence and learning outcomes in the

study program curriculum is primarily in the aspect of feed quality related to the production and reproduction performance of livestock and the safety of livestock products as one of the food chains of animal origin. The quality of feed dramatically influences the quality of livestock products. Moreover, feed cost is the highest component (70-80%) in commercial livestock production. Farm owners face the biggest challenge to choose and formulate the least cost from various sources, types, and quality of feed.

Wild forages and green fodder are the primary feed source for ruminants of cattle, buffaloes in West Sumatra. The livestock raised in small flock size by confining in a simple house at night and tethering out the cages to graze during the day around the farm or villages [2]. Some farmers offered additional forages in the afternoon. The forages are collected from various lands, such as plantations, rice fields, idle land, road, or riversides. The quality of these wild plants will vary due to the influence of land, age, type, and part of the plant [3]. Grazing livestock will select and consume the palatable plant types containing essential nutrients and less the risk of undesirable substances. Moreover, farm owners choose and collect the same kind of palatable plant species for additional forages for feeding their livestock by the cut-and-carry feeding system.

However, farm owners could not offer their animals only the palatable species due to the shortage of quality and growth characteristics of wild vegetation. The constraints in the availability of quality fodder feed often forced the farm owner to collect all types of plants to meet feed requirements. It is also unlikely that the edible species will provide the livestock with a complete nutrient [4]. The students focused on the feed and animal nutrition needs field experiences on the diversity of palatable wild forages directly consumed during grazing or keeping on the farm.

The present project-based learning (PjBL) objective was to offer the students practical sampling techniques of feeding and standing forages to gain experience in the diversity of plant species usually provided and consumed by goats raised by traditional farms Payakumbuh region. The students gained experiences from the farm owners and their livestock on the various natural resources available around the

farms or villages potentially used for feeding livestock animals.

## 2. MATERIAL AND METHODS

The PjBL program in this study was implemented by offering an assignment to the students enrolled in the Feed Quality Control Subject with the topic "Analysis of Botanical and Chemical Composition of Forages Fed for Goat in Payakumbuh region". The program was initiated by visiting and interviewing goat farm owners, then collecting forage samples for botanical identification and laboratory analysis. Data were analyzed and presented in a scientific paper.

### 2.1. Preparation and Description of PjBL program

Implementation of the program was started by preparing a project outline as a job description (uraian tugas). The job description comprises background, purposes, implementation procedures, data analysis, scientific paper format, evaluation points, and schedules. The project outlines and procedures were explained to and discussed with the students for understanding and getting feedback. The students were divided into five groups and assigned to prepare materials and tools, locations, goat farms as respondents, a list of data and questions for the farm owner, data, photo and audio documentation, and schedule.

The students were allowed to visit and select a goat farm as respondents for each group. The selected farms are located in the Payakumbuh region, which covers the city of Payakumbuh and the district of Limapuluh Kota. The students described the program to the respondents and made an appointment for an interview and feed sampling.

## 2.2. Data collection and forage sampling.

The student visited goat farms in the afternoon and discussed with the farm owners. The mean flock size of goats reared by the selected farms was 13.6 goats which were composed of does (3.2), buck (2.8), young does (1.8), and kids (5.8 heads/farm). Farm owners were interviewed on-farm using a questionnaire to collect data on herding and feeding practices, grazing areas, flock size, age, experience, marketing, and reproductive and production performances of goats. During the farm visit, samples of fodder feed were taken in the farm and grazing areas in fresh form. Forage samples in the farms were collected at five individual sampling points at forage bunches or sacks directly after the collected forages arrived in the afternoon.

The students tethered goats for collecting forage samples in grazing areas. Forage samples in the grazing regions were collected by following a tethered goat during free browsing in five different grazing areas: coconut plantations, banana plantations, roadsides, riversides, and idle lands. The students cut the plants with a stainless steel knife according to the choice of the animal or parts bitten by goats. The individual samples were placed in a separate plastic bag, weighed, and sorted by plant species to identify local and Latin names. The students could compare the diversity of plants given or consumed by livestock in the cage with the plants freely chosen and preferred by goats in grazing land. Forage samples were then chopped, dried, and ground into powder form to analyze moisture, dry matter, and ash content in the Integrated Laboratory of Campus II Payakumbuh.

## 2.3. Documentation, data analysis, and preparation of a scientific paper

All activities in the farms and laboratory were documented by

photography and live video. Photos were arranged in tabular form following the order of actions. Data of identified plant species were recorded in an excel form for calculation and graphic presentation. The students were required to submit three documents, photos and videos, and data. The proposed document was discussed in the class, and feedback for improvement was pointed before final submission.

The assignment was finalized with an individual scientific paper. Students were supervised to describe the project scientifically, starting from the background, objectives, implementation procedures, data presentation, discussion, and conclusion. Students needed to explain the various types of plants potentially used for animal feed in the discussion. The students were also supported to find out relevant literature. The students were also expected to have confidence that livestock ruminants could be fed by using natural resources.

## 2.4. Assessment criteria

Assignment assessments were based on:

- Teamwork, discipline, and seriousness
- Quality of photos and video
- Accuracy and presentation style of data
- Quality of scientific papers (format, completeness of content, grammar, and documentation).

## 3. RESULTS AND DISCUSSION

### 3.1. Diversity of forages for goat

The diversity of forages fed to or consumed by a goat in the Payakumbuh region was presented in Table 1. There were about 45-46 plant species used for feeding goats in the study sites. The present results are consistent with the previous research on the diversity of forages fed to meat-type goats in the Payakumbuh region

[5]. They comprised about 31-43% grasses, 37-42% broadleaves, 9% legumes, 2-11% tuber leaves, and 7-9% tree leaves. Grasses and broadleaves that account for 68-85% were essential forages for feeding goats raised traditionally in the Payakumbuh region. The present results are supported by Malechek and Provenza [6], who reported that goats consumed 60% shrub, 30% grass, and 10% big leaves by grazing in a grassland. Lee et al. [7] confirmed that forages consumed by goats are composed of 34% of wild and 66% herbaceous plants.

Grasses were dominated by native *Axonopus compressus*, *Panicum maximum repens*, *Paspalum conjugatum*, *Ottlochloa nodosa*, *Brachiaria milliformis*, *Brachiaria mutica*, *Ischaenum mucunoides*. *Axonopus sp*, composed of about 23%, was the most important grass species, followed by *Panicum sp* (5.3%) and *Paspalum sp* of 4.0%. *Axonopus* and *Paspalum*, known as high palatable and shade-tolerant species was commonly found growing as weeds under rubber and palm crop plantations, while *Panicum maximum* was widely seen in banana and coconut plantations [8].

There was a slight difference in the diversity of plant species consumed by a goat in the grazing areas with those fed by the farm owner. As shown in Table 1, goats consumed more types and variety of grasses by free grazing (standing forages) than grasses offered by the farm owner (feeding forages). On the other hand, higher broadleaves species fed to goats (42%) than consumed by free grazing (37%). It means that farm owners offered better forage quality than that found by goats by grazing. These plant species were very palatable for goats and grew widely in various lands Payakumbuh region [3].

### 3.2. Dry matter and crude ash content of forages

Table 2 shows the mean dry matter (DM) and crude ash content of foraged fed to or consumed by a goat in the Payakumbuh region. The nutritive values of forages used for feeding goats in Payakumbuh were found relatively high. The DM content ranges from 19 to 27 % FW, while crude ash ranges from 6-9% DM. Forages had low DM and crude ash content. Khalil [4] (2016) reported that legumes and tree leaf contained lower CF and higher CP compared to grasses. Legumes also had a relatively high P of about 11-13 g/kg DM.

Goat preferred and tended to select the soft type or parts of plants. The student realizes that the farm owners might be able to meet the preference plants for their animals. It is different from other ruminant livestock like cattle and buffalo; goats are browsers, had selective foraging behavior, and tend to select young and soft parts of vegetation [9,10]. As shown in Table 2, broadleaves had the lowest dry matter content of 19.4% fresh weight (FW), compared to grasses (24.1 %) and legumes (27.4%). According to Tolera and Abebe [11], browse species have high crude protein content ranging from 10 to more than 25%, making them a more reliable, high-quality feed resource. Goat owners were able to identify which kinds and parts of the browse plants were favored by the goats. This data also shows that farmers in Payakumbuh were able to explore the potential of various forage sources to feed their goats.

## 4. CONCLUSION

The students experienced that there is a wide variety of locally available plant species utilized as green fodder feed for goats in Payakumbuh. The forages offered are mainly composed of native grasses, broad leaves, legumes, and tree leaves. The students realized that farm owners

selected palatable and nutritious plant species according to the preference of their livestock.

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**Table 1 Diversity of forages for feeding goats in the Payakumbuh region**

Forage group	Plant species fed to goats in the farm ( <i>feeding forages</i> )	Number of plants	Plant species consumed by goats by grazing ( <i>grazing forages</i> )	Number of plants
Grasses	<i>Axonopus compressus</i> , <i>Panicum maximum</i> , <i>Cyperus rotundus</i> L., <i>Bracharia decumbens</i> , <i>Setaria sphacelata</i> , <i>Pennisetum purpureum</i> , <i>Pennisetum purpureum</i> cv. <i>Mott</i> , <i>Paspalum dilatatum</i> , <i>Eleusine indica</i> L., <i>Digitaria eriantha</i> , <i>Hedyotis corymbosa</i> L. <i>Lophatherum gracile</i> , <i>Leersia hexandra</i> and <i>Cynodon dactylon</i> .	14	<i>Axonopus compressus</i> , <i>Cyperus rotundus</i> , <i>Paspalum conjugatum</i> , <i>Pennisetum purpureum</i> , <i>Imperata cylindrica</i> , <i>Setaria sphacelata</i> , <i>Cynodon dactylon</i> , <i>Digitaria ciliaris</i> , <i>Eleusine indica</i> , <i>Panicum repens</i> , <i>Paspalum dilatatum</i> , <i>Panicum maximum</i> , <i>Brachiaria mutica</i> , <i>Pennisetum purpureoides</i> , <i>Lophatherum gracile</i> , <i>Vernonia cinerea</i> , <i>Smallanthus sonchifolius</i> , <i>Lepironia articulata</i> , <i>Hyptis capitata</i> dan <i>Leersia hexandra</i> .	20
	Subtotal: 31.11%		Subtotal: 43.47%	
Broad leaves and fern	<i>Asystasia gangetica</i> , <i>Mimosa pudica</i> , <i>Commelina nudiflora</i> L., <i>Ageratum conyzoides</i> , <i>Cleome ruidosperma</i> DC, <i>Mikania micrantha</i> , <i>Stachytarpheta jamaicensis</i> , <i>Momordica charantia</i> , <i>Crassocephalum crepidioides</i> , <i>Amaranthus spinosus</i> , <i>Centella asiatica</i> , <i>Borreria alata</i> , <i>Synedrella nodiflora</i> , <i>Isotoma longiflora</i> , <i>Anthurium cystalinum</i> , <i>Commelina benghalensis</i> , <i>Emilia sonchifolia</i> , <i>Nephrolepis exaltata</i> , and <i>Euphorbia hirta</i> .	19	<i>Asystasia gangetica</i> , <i>Polypodium vulgare</i> , <i>Ageratum bonyzoides</i> L., <i>Stachytarpheta jamaicensis</i> , <i>Chenopodium album</i> L, <i>Cyathula prostrata</i> , <i>Shida rhombifolia</i> , <i>Mimosa pudica</i> , <i>Digitaria sanguinalis</i> , <i>Commelina diffusa</i> , <i>Tithonia diversifolia</i> , <i>Brachypodium sylvaticum</i> , <i>Mikania micrantha</i> , <i>Melastoma malabathriam</i> , <i>Eclipta prostrata</i> , <i>Acmella paniculatang</i> , dan <i>Mesoma chinensis</i>	17
	Subtotal:42.22%		Subtotal: 36.96%	
Tuber leaves	<i>Manihot utilisima</i> , <i>Ipomoea batatas</i> L., <i>Emilia sonchifolia</i> , <i>Colocasia esculenta</i> L., dan <i>Caladium</i> sp.	5	<i>Manihot utilisima</i>	1
	Subtotal: 11.11%		Subtotal: 2.17%	
Legumes	<i>Centrosema pubescens</i> , <i>Glycine max</i> , <i>Pueraria phaseoloides</i> , and <i>Calopogonium mucunoides</i> .	4	<i>Centrosema pubescens</i> , <i>Calopogonium mucunoides</i> , <i>Pterocarpus indicus</i> dan <i>Arachis hypogaea</i>	4
	Subtotal: 8.89%		Subtotal: 8,70%	
Tree leaves	<i>Gliricidia sepium</i> , <i>Tectona grandis</i> , and <i>Indigofera tinctoria</i> .	3	<i>Gliricida sepium</i> , <i>Curcuma zedoaria</i> , <i>Syzygium oleana</i> dan <i>Theobroma cacao</i>	4
	Subtotal: 6.67%		Subtotal: 8.70%	
	Total number of plants	45		46

Table 2 Dry matter and crude ash composition of selected forages fed to goats in the Payakumbuh region

Forage group	No	Species name	DM (% FW)	Crude ash (% DM)
Grasses	1	<i>Axonopus compressus</i>	20.06	6.99
	2	<i>Lersia hexandra</i>	24.53	12.50
	3	<i>Hyptis capitata</i>	18.46	12.04
	4	<i>Cyperus rotundus</i>	23.31	6.35
	5	<i>Lepironia articulata</i>	32.64	1.56
	6	<i>Pennisetum purpureum</i>	22.94	10.22
	7	<i>Setaria anceps</i>	31.01	9.63
	8	<i>Imperata cylindrica</i>	34.21	6.81
	9	<i>Smallanthus sonchifolius</i>	18.08	12.30
	10	<i>Vernonia cinerea</i>	19.43	9.04
	11	<i>Panicum Maximum</i>	23.31	11.11
	12	<i>Lophatherum gracile</i>	20.97	10.81
	<b>Mean</b>		<b>24.08</b>	<b>9.11</b>
Broad leaves and fern	1	<i>Mikania micrantha</i>	12.27	10.87
	2	<i>Melastoma malabathriam</i>	29.62	5.26
	3	<i>Ageratum conyzoides</i>	14.49	2.63
	4	<i>Eclipta prostrata</i>	29.77	6.42
	5	<i>Asystasia gangetica</i>	16.12	8.60
	6	<i>Acmella paniculatangn</i>	15.42	12.97
	7	<i>Mesoma chinensin</i>	16.30	8.99
	<b>Mean</b>		<b>19.14</b>	<b>7.96</b>
Legumes	1	<i>Mimosa pudica</i>	26.63	3.21
	2	<i>Pterocarpus indicus</i>	31.85	7.25
	3	<i>Arachis hypogaea</i>	23.69	6.91
	<b>Mean</b>		<b>27.39</b>	<b>5.79</b>
Tuber and tree leaves	1	<i>Manihot esculenta</i>	21.34	8.21
	2	<i>Curcuma zedoaria</i>	18.90	6.88
	3	<i>Syzygium oleana</i>	20.15	10.26
	4	<i>Theobroma cacao</i>	16.30	5.82
	5	<i>Gliridia sepium</i>	24.06	5.91
	<b>Mean</b>		<b>19.17</b>	<b>7.79</b>
<b>Mean</b>			<b>20.15</b>	<b>7.42</b>

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