Species of forages utilized by farmers producing halal goats in Bangsamoro Autonomous Region in Muslim Mindanao (BARM), Philippines

GERALDSON A. NAVARRA1, FLORENCE ROY P. SALVAÑA2,3,4, ELMA G. SEPELAGIO5, CARLITO B. SANCHEZ2, CYRELLE M. BESANA3, LEANNES JAY S. MANCERAS5, SULOG G. BRA6

1Bureau of Animal Industry (BAI), Cotabato City, Philippines
2Graduate School, University of the Philippines Los Baños, College, Laguna, Philippines. *email: rdsalvana@usm.edu.ph
3Department of Biological Sciences, College of Arts and Sciences, University of Southern Mindanao, Kabacan, Cotabato, Philippines
4Philippine Council for Agriculture, Aquatics and Natural Resources Research and Development (DOST-PCAARRD), Brgy. Timugan, Los Baños, Laguna, Philippines
5Department of Clinical Veterinary Sciences College of Veterinary Medicine, University of Southern Mindanao, Kabacan, Cotabato, Philippines
6Mindanao State University-Maguindanao, Dinaig, Datu Odin Sinsuat, Maguindanao, Philippines

Abstract. Navarra GA, Salvaña FRP, Sepelagio EG, Sanchez CB, Besana CM, Manceras LJS, Bra SG. 2019. Species of forages utilized by farmers producing halal goats in Bangsamoro Autonomous Region in Muslim Mindanao (BARM), Philippines. Asian J Ethnobiol 2: 1-7. Local production of small ruminants necessitates forage assessment considering the fact that animals are typically fed with locally available plant species. This study was carried out to determine the species of plants used as forage by raisers producing halal goats in BARM (Bangsamoro Autonomous Region in Muslim Mindanao). Personal interview with the respondents producing halal goats was conducted and a questionnaire was used to determine species of forages. A total of eight municipalities were included in the survey. Seven of which were from Maguindanao and one was from Lanao del Sur. Purposive sampling was used in the survey. A total of 47 respondents was interviewed based on the criteria: (i) a believer of Islam (ii) with 5 to 24 breeder does; and (iii) willingness of the farm owner to participate in the survey. All respondents fall to these criteria were interviewed. All respondents used forage species including paragrass (Brachiaria mutica), carabao grass (Paspalum conjugatum), ipil-ipil (Leucaena leucocephala) and kakahate (Gliricidia sepium) in all sampling sites. Other species included malunggay (Moringa oleifera), banana (Musa babusiana), stylo (Stylosanthes humilis), centrosema (Centrosema pubescens), langka (Artocarpus heterophyllus), pinto peanut (Arachis pintoi), napier (Pennisetum purpureum), barnyard grass (Echinochloa sp.), Guinea grass (Panicum maximum), indigofera (Indigofera tinctoria), calliandra (Calliandra calothyrsus), katurai (Sesbania grandiflora) and rensonii (Desmodium rensonii). Only eleven percent (11%) of the respondents utilized improved and domesticated species of forages. Improved and domesticated forage species are plants commonly cultivated forage for livestock production. Some species of plants present in open vegetated areas like Erigeron canadensis, Sphagnetica trifolata, Ageratum conyzoides and Urena lobata were also consumed by goats according to the respondents. There were also plant-related toxicosis observed by the respondents caused by C. pubescens and Urena lobata. Most of the respondents in BARM are not utilizing improved and domesticated species of forages and rely on locally available forages present in rangeland. Most of them have limited knowledge of the nutritional requirements of goats. There is a need to enhance the understanding of farmers on the importance of proper forage selection and combination.

Keywords: BARM, forage, goats, halal

INTRODUCTION

Halal means “permissible” and, more often than not, it is being applied to as a preferred method of animal slaughter (Ibrahim 2011). The term is also used for food and products which are acceptable to individuals practicing Islam. Farouk et al. (2016) added that it is not just the way animals are slaughtered but also includes how they are raised. Products labeled as Halal meet standards of quality assurance (Ambali and Bakar 2014). Among Halal food products, goat meat is one of the most important exported and imported commodities. Globally, established Halal meat production facilities are located in Islamic countries such as Indonesia, Malaysia, Pakistan, and Saudi Arabia. Non-Islamic countries like Singapore are also known to produce Halal goat meat in international trade (E-Halal Organization 2010). There have been issues with the authenticity of Halal meat and meat products. Nakyinsige et al. (2012) provided a complete review of these issues. Some of these issues include pork substitution, undeclared blood plasma, the use of prohibited ingredients, pork intestine casings, and non-halal methods of slaughter.

Halal goat production is becoming an economically viable enterprise in the Philippines. Some of the identified regions in the Philippines producing Halal goats include Bangsamoro Autonomous Region for Muslim Mindanao (BARM) and Region XII (SOCCKSARGEN). Based on the number of goat heads nationwide, 4.55% of goats are from BARM. All raisers in the region practiced backyard raising which constitutes 4.61% of all backyard raisers in...
the country. There is a total annual volume of production of 644 metric tons live weight. Based although the per capita consumption is only 0.21 kg per year, Halal goats are commonly used by Muslims as a sacrifice in the observance of their faith especially during religious occasions such as Kanduli, Aqiqah, Ramadan, Eid al-Adha, and Eid al-Fitr. One of the main reasons for this increase in demand is the belief that Halal meat,  

The Philippine Halal products and services in 2017 were at Php 5.52 billion or 8.73% of the country’s total export. Currently, Halal goat industry in the Philippines is still in its infancy with minimal annual production, and resources, like forages, devoted for this are not documented. Naanep et al. (2009) also observed that goat raisers had inadequate knowledge of various Halal goat production aspects. Knowing this, there is a need to consider evaluation of resources that are suitable and acceptable in Halal goat production.

One of the basic resources needed to be considered in livestock production is forage. Forage assessment is an important consideration, especially in goat raising producing halal meat, since there is no available Halal certified feed concentrate. Moreover, backyard goat raisers commonly used locally available plant species as forage (Nampanzira et al. 2015). The type of forage used for livestock production has nutritional and health implications. Naturally, goats are considered active foragers and browsers. Browsers refer to the leaves and twigs from shrubs and trees available to ruminants, such as goats, as feed. Free-forage individual goats are able to cover a wide area in search of plant materials. The morphology of goat’s mouth enables them to pick small plant parts choosing most nutritious available feed. Given the opportunity, goats select over 60 percent of their daily diet from bush and woody perennials, and broadleaf plants over herbaceous species (Mkhize et al. 2014). As browsers, goats have been observed to stand on their hind legs and stretch up to browse the leaves. They can also throw their bodies against saplings to bring the tops within reach. Goats are also observed to climb trees or shrubs to consume preferred forage (Schlecht et al. 1999). In pasture areas, they tend to graze from top to bottom of plants and do not like to graze near the soil surface. In this type of feeding strategy, goats select grasses when the protein content and digestibility are high. However, they tend to switch to browse when these nutritive values are higher (Bojkovski et al. 2014). Most backyard goat raisers rely on vegetated areas for forages and establishment of improved pasture is minimal (CosADIO et al. 2011). Also, proper feeding ratio is not observed and feeding is dependent on available plant species regardless of nutritional value. On the other hand, rangelands, wherein most farmers are dependent, may be contaminated with plants known to be toxic to animals. There have been cases of poisoning, with considerable mortality rate, due to the consumption of large amounts of toxic plants (Krueger and Sharp 1978). Moreover, most of the browse species preferred by goats are legumes and contain a higher amount of tannins. Tannins have adverse and beneficial effects depending on their concentration and nature, and animal species, physiological state of the animals, and composition of the diet (Makkar 2003). Goats, as concluded by Sultanikove et al. (1996), have the ability to consume a large amount of tannin-rich plants. A level of tannin below 5 percent seems to be tolerable for ruminant animals (Ebong 1995). While tannins are best known as an anti-nutritional factor, there is a long list of plant secondary products, such as cyanide, nitrate, fluoracetate, cyanogenic glycosides, saponins, oxalates, mimosine, and various sterols, present in most browse species (Leng 1997).

As they constitute a big portion of Halal goat production, forage assessment is necessary to address nutrition and health problems. It is one way to educate Halal goat raisers on proper forage selection and enhance their understanding of the importance of establishing their own pasture planted with improved and domesticated species of forages.

MATERIALS AND METHODS

Location of the study
The study was conducted in some provinces of the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) consisting of five predominantly Muslim provinces: Basilan (except Isabela City), Lanao del Sur, Maguindanao, Sulu, and Tawi-Tawi. BARMM traverses two geological territories: Lanao del Sur and Maguindanao (recently Cotabato City included) in southwestern Mindanao, and the island areas of Basilan (with the exception of Isabela City), Sulu and Tawi-Tawi in the Sulu Archipelago.

Municipalities included in the study were selected using purposive sampling with 2 criteria; (i) barangays (small areas which constitute to a municipality) whose municipalities are producing sizeable heads of goats based on the reports provided by the Municipal Agriculture Office, and (ii) consideration of the peace and order condition of the area. Based on records, two provinces have the highest concentration of goats, in Maguindanao and Lanao del Sur. From Maguindanao, 7 municipalities were selected, namely Ampatuan, Datu Odin Sinsuat, North Upi, Sultan Kudarat, Sultan Mastura, Buldon, and Parang and from Lanao del Sur, only the Municipality of Balubagan. Respondents from these municipalities were purposely selected. The location of each respondent’s farm was determined and a map was generated (Figure 1).

Respondents and sampling procedures
Prior to sampling, meetings with the Provincial Agricultural Officer, Municipal Agricultural Officers, livestock technicians, and Barangay Chairpersons of the different barangays with highest concentration of goats were done to discuss the rationale of the study.

A total of 47 respondents were interviewed. Socio-demographic information of each respondent was determined including age, sex, educational attainment, civil status, occupation and herd size. Selection of respondents in each municipality was based on the following criteria: (i) a believer of Islam (ii) with 5 to 24 breeders does; and (iii) willingness of the farm owner to participate in the survey.
An on-farm assessment of resources included actual farm visitation and interviews of respondents. Each respondent was interviewed on the species of plants they used as forage.

Data analysis
Species richness represents the number of forage species provided by each respondent. Each species was ranked based on the frequency the species was mentioned by all respondents. Shannon-Weiner Index was used to determine the diversity of forage species in each site.

RESULTS AND DISCUSSION

Socio-demographic profile of the respondents
Table 1 shows the socio-demographic profile of the respondents. Among the 47 respondents, 80% were male and 20% are female. Respondents’ age ranged from 19-80 years old with a mean of 40.7. Twenty percent (20%) of the respondents were elementary graduates, 60% were high school graduates and 20% were college graduates. Most of the respondents were married (98%) and 2% were single. Aside from goat raising, 22% of the respondents have other jobs like employment in Local Government Units (LGU), University and carpentry work. Others were engaged in crop farming (66%) and 12% primarily depends on goat raising. In terms of herd size, 20% of the respondents have > 20 breeder does while 80% have 5-20 breeder does. Most of the respondents stated that they sell their goats for school and emergency expenses. Only few of them slaughter their goats for personal consumption during special occasions.

Table 1. Socio-demographic profile of the respondents

| Indicators              | n  | Percentage (%) |
|-------------------------|----|----------------|
| Age                     |    |                |
| 19-33 years old         | 15 | 31             |
| 34-48 years old         | 24 | 51             |
| 49 years old and above  | 8  | 18             |
| 40.7 years old          |    |                |
| Mean age                |    |                |
| Sex                     |    |                |
| Male                    | 37 | 80             |
| Female                  | 10 | 20             |
| Educational attainment  |    |                |
| Elementary Graduate     | 9  | 20             |
| High School Graduate    | 29 | 60             |
| College Graduate        | 9  | 20             |
| Civil status            |    |                |
| Single                  | 2  | 2              |
| Married                 | 45 | 98             |
| Occupation              |    |                |
| Farming                 | 32 | 66             |
| Goat                    | 5  | 12             |
| Other                   | 10 | 22             |
| Herd size               |    |                |
| 5-20 does               | 37 | 80             |
| > 20 does               | 10 | 20             |

Species of forages
Based on the results of the interview, a total of 17 plant species were used by the respondents as forage. Out of the 17 species, four were used by all respondents as forage, namely paragrass (*Brachiaria mutica*), carabao grass (*Paspalum conjugatum*), ipil-ipil (*Leucaena leucocephala*), and kakawate (*Gliricidia sepium*) (Figure 2).
Most of the respondents also used malunggay (*Moringa oleifera*), banana (*Musa balbisiana*) leaves, stylo (*Stylosanthes humilis*), langka (*Artocarpus heterophyllus*) leaves, and centrosema (*Centrosema pubescens*) (Figure 3).

Among the respondents, less than 20% were using pinto peanut (*Arachis pintoi*), barnyard grass (*Echinochloa* sp.), napier (*Pennisetum purpureum*), Guinea grass (*Panicum maximum*), indigofera (*Indigofera tinctoria*), caliandra (*Calliaandra calothyrsus*), katurai (*Sesbania grandiflora*) and rensonii (*Desmodium cinereum*) (Figure 4). It was also documented that only few of the respondents (11%) were establishing some of the aforementioned improved forages. Other respondents collect forages from vegetated areas or tethered goats in rangeland. Improved forages are species of plants commonly cultivated for livestock production.

Most of the respondents practiced tethering in open vegetated areas. According to them, goat consumed other plant species where they are tethered including *Erigeron canadensis*, *Ageratum conyzoides*, *Sphagneticola trilobata* and *Urena lobata* (Figure 5). Identification of these plants was based on the statement of the respondents coupled with field observation together with the respondents.

There were also issues stated by farmers related to forages. In Buldon (Maguindanao) and Balabagan (Lanao del Sur), *C. pubescens* (Figure 3-d) were most common and abundant legume, however, they seldom use this species since it has been associated with diarrhea cases in goats. In addition, respondents observed more than 60 deaths of goat after consuming large amounts of *Urena lobata* (Figure 5-d) in Datu Odin Sinsuat, Maguindanao. According to them, it is the only available plant species, especially during dry season.

**Diversity index**

Table 2 shows the computed diversity index values in each sampling site. Highest Shannon-Weiner index was recorded in Balabagan, Lanao del Sur (2.369). This was followed by Ampatuan (2.288), Buldon (2.172) and Parang (2.043), all in Maguindanao. Sultan Kudarat, Maguindanao had the lowest Shannon-Weiner diversity index (1.609).

**Table 1.** Species richness and Shannon-Weiner Index of each sampling sites

| Sampling site                        | Species richness (n) | Shannon-Weiner Index (H) |
|--------------------------------------|----------------------|--------------------------|
| Ampatuan, Maguindanao                | 10                   | 2.288                    |
| Buldon, Maguindanao                  | 9                    | 2.172                    |
| Datu Odin Sinsuat, Maguindanao       | 7                    | 1.661                    |
| Upi, Maguindanao                     | 7                    | 1.898                    |
| Parang, Maguindanao                  | 9                    | 2.043                    |
| Sultan Kudarat, Maguindanao          | 5                    | 1.609                    |
| Sultan Amstura, Maguindanao          | 7                    | 1.872                    |
| Balabagan, Lanao del Sur             | 15                   | 2.369                    |

**Figure 2.** Habit of (A) paragrass (*Brachiaria mutica*), (B) carabao grass (*Paspalum conjugatum*), (C) ipil-ipil (*Leucaena leucocephala*) and (D) kakawate (*Gliricidia sepium*).

**Figure 3.** Habit of (A) malunggay (*Moringa oleifera*), (B) banana (*Musa balbisiana*), (C) langka (*Artocarpus heterophyllus*) and (D) centrosema (*Centrosema pubescens*)
Discussion

It can be noted that forages used by the respondents differ from region to region, however, similarities may be observed especially species that are well-known as forage. All of the respondents utilized paragrass (*Brachiaria mutica*), carabao grass (*Paspalum conjugatum*), ipil-ipil (*Leucaena leucocephala*), and kakawate (*Glinicidia sepium*). In the study of Fuentes et al. (2006), these species were also commonly used by conventional goat raisers in the nearby region of Davao (Philippines). In most cases, *B. mutica*, *L. leucocephala* and *G. sepium* are used for cut-and-carry feeding systems while *P. conjugatum* is grazed by goats in an open field. In the Philippines, Gerpacio and Castillo (1979) established a list of feedstuffs for goat production with their respective nutrient composition. The list includes some forage species like napier grass (*Pennisetum purpureum*), paragrass (*Urochloa mutica*), star grass (*Cynodon plectostachyus*), Guinea grass...
(Panicum maximum), flemingia (Flemingia macrophylla), ipil-ipil (Leucaena leucocephala), centrosema (Centrosema pubescens), siratro (Phaseolus atropurpureus), calliandra (Calliandra calothyrsus), kakawate (Gliricidia sepium), pigeon pea (Cajanus cajan), mulberry (Morus alba) and rensonii (Desmodium rensonii). Among these forages, goats are known to relish paragrass, stargrass, napier grass, Guinea grass, and centrosema over improve tropical grasses and legumes.

Moreover, Fujihara et al. (2006) evaluated the mineral nutrition of grazing goats and have enumerated some forage species in pasture areas for goats in Luzon. Several species of forages identified include Axonopus compressus, Brachiaria mutica, Cynodon plectostachyus, Eleusine indica, Imperata cylindrical, Pennisetum purpureum, Rottboellia exaltata, Gliciridia sepium, Aeschynomene indica, Calopogonium mucunoides, Centrosera pubescens, Desmodium tortuosum, Leucaena leucocephala, and Seshania sesban.

Among the Brachiaria species, it is only B. mutica can thrive well in waterlogged areas (Cardoso et al. 2013). The availability of this species to all respondents interviewed can be explained by the location of sampling areas. Based on the map (Figure 1), most of the sampling areas are located near bodies of water which favors the growth of B. mutica.

Both L. leucocephala and G. sepium are multipurpose forages. It is important for farmers to select species that can be used in different ways in the farm. These two species are not only protein-rich forage that can be used for ruminants but has other significant uses in the farm such as fuelwood, fence, live post, shade, and windbreak. In addition, these species are easy to propagate using only stem cuttings (Mangesho et al. 2017). They are also common in open, shaded and unutilized areas. Leucaena leucocephala is also known to be well-adapted in different environmental conditions in the tropics. It can also maintain green leaf and remain productive throughout a long dry season (Dubeux et al. 2017). On the other hand, Bestil et al. (2014) stated that Paspalum conjugatum has greater potential as ruminant feed, however, the quantity of forage that can be obtained from the species and its versatility to grow in marginal areas are its limitation when utilized as forage.

Most of the respondents also used Moringa oleifera, Musa balbisiana leaves, Stylosanthes humilis, Axonopus compressus and Artocarpus heterophyllus leaves. In the study of Manh et al. (2005), M. oleifera can be used as sole feed for goats compared to L. leucocephala. Makkar and Becker (1996) also added that Moringa foliage is a good and inexpensive protein source, and has low anti-nutritional factors. Banana leaves can be used as supplemental forage but not as sole forage. It is not enough to supply the nutritional requirements of goats. Although, leaves of banana can be an alternative to reduce weight loss of goats in case of reduction of forage availability especially during dry season (Pathommalangsy and Preston 2008). This is in agreement with the results of the interview wherein most of the respondents stated that banana leaves are utilized as supplemental feed. Stylosanthes humilis and Centrosema pubescens are also used as protein source for goats. Stylo is suited for forage in subhumid tropical and subtropical areas with marked dry season and applicable for cut and carry systems (Cook et al. 2005). Centrosema pubescens trailing-climbing forage crop with crude protein content ranges from 20 to 26% usually intercropped with grasses, small tree legumes and shrubs. In the upland areas of Leyte (Philippines), Artocarpus heterophyllus leaves are commonly fed in goats and have the potential to be supplemental foliage based on in-situ degradation since it may provide greater by-pass nutrients for utilization at the intestinal level (Bestil et al. 2014).

It is interesting to note that less than 20% of the respondents utilize improved species of forages. This result is commonly attributed to two factors including limited land area, expenses for improved pasture establishment and unavailable planting materials for improved species of forages. Due to limited land area, a considerable number of respondents practiced cut and carry system of feeding their animals. Forage establishment bears additional costs for farmers. Costs may include planting materials, maintenance and even fencing. In the study of Cosadio et al. (2011), although improved pasture establishment should be prioritized, most of the farmers only utilized open vegetated areas due to these constraints. Some farmers establish improved pasture but utilizing native species. Unable to establish improved pasture with domesticated forage species can also be attributed to the existing knowledge of the respondents. Farmers are generally not aware of whether or not their goats have satisfied the daily nutritional requirements. They have nutritional needs of goats and feeding technology that can boost goat performance (Alcedo et al. 2015).

More than 60 deaths were recorded in Datu Odin Sinsuat, Maguindanao due to consumption of Urena lobata. Rangeland is composed of different species of plants that can be of poor nutritional value and contain toxic compounds. It is common that these plants are abundant especially during extreme conditions like drought while other plants are not capable of surviving. In these manners, animals dependent on these plants like goats have no other options but to consume what is available in the field. It can be noted that plant poisoning is due to either accidental ingestion of material consumed along with forages or willful consumption of poisonous plants (Mugera 1970). This event is common to livestock, goats in particular, due to their dietary plasticity. Moreover, their capacity to access preferred and desirable plant species is also associated with poisoning events. Limited pasture areas and rangeland results in an increased incidence of animal poisoning (Damiran and Darambazar 2003). Non-conventional forage as a supplement to the poor quality and inadequate grasses during the dry season can be also attributed to plant-related poisoning which is common in the topics (Olafadehan 2011). Poisoning events also depend on grazing behavior and animal susceptibility to plant toxins. In most cases, lesser production losses are observed when animals grazed on several species of forages compared to single species consumption. Moreover, variations in the palatability of plants to animals also affect cases of poisoning (Ralphs and Provenza 1990). Cardiac
glycoside, a toxic compound in most animals, is present in *Urena lobata* which can be the cause of death cases of goats (Fagbohun et al. 2012).

Based on Shannon-Weiner index, Balabagan had the highest value corresponding to high diversity. This result can be attributed to the higher number of forage species identified and used by the respondents in the area. This index measures the species abundance and richness which can be the reason for high diversity in Balabagan, Lanao del Sur (Gaines et al. 1999). In addition, Shannon diversity index ranges from 1.5 to 3.5 wherein the computed values in all sampling sites belong to this range which supports the accuracy of the results.

In conclusion, most of respondents utilized feed resources available in open vegetated areas. Only few of them are using improved and domesticated species of forages which can be due to limited land area, additional expenses in establishing improved forages, and unavailable planting materials.

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