
EFFECT OF MIXING LOW PALATABLE GRASSES AND IPIL IPIL LEAVES ON FORAGE QUALITY

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ABSTRACT:- The study was conducted at the National Agricultural Research Centre, Islamabad, Pakistan to investigate the impact of mixing low palatable grasses namely *Heteropogon contortus*, *Desmostachya bipinnata*, *Sorghum halepense* and *Chrysopogon aucheri* with tree leaves of *Leucaena leucocephala* (Ipil ipil) in the ratio of 75:25, 50:50, 25:75, along with sole species on their chemical composition. Samples were analyzed for proximate parameters (crude protein (CP), crude fiber (CF), total ash and ether extract (EE)). The results revealed that there were significant differences in dry matter (DM) among different grasses. DM content of low palatable grasses was generally high (70-75%) as compared to Ipil ipil leaves (45-55%). DM content among mixtures was also variable. For the treatment grass 75% + Ipil ipil 25%, DM range was 65-70%, for grass 50% + Ipil ipil 50%, it was 60-65% and for grass 25% + Ipil ipil 75%, it was 55%. The CP value of the treatments showed significant variation ranging from less than 10% in grasses to almost 30% in pure Ipil ipil leaves. The mixtures had CP content corresponding to proportions of grasses and legume tree leaves. The CF values also varied significantly among the treatments. Grasses had in general higher CF content than legume leaves. It can be concluded that addition of Ipil ipil leaves to grasses improved overall nutrition especially CP of the feed.

Key Words: Low Palatable Grass; Heteropogon contortus; Desmostachya bipinnata; Sorghum halepense; Chrysopogon aucheri; Leucaena leucocephala; Dry Matter; Crude Protein; Crude Fibre; Total Ash; Ether Extract; Pakistan.

INTRODUCTION

The place where the rain is erratic or low and topography is uneven for dry land crops production are called rangeland and this is the earth's biggest land type. It is utilized as grazing resource that generates forage for livestock. For the survival of human race, all these rangelands play a vital role in providing a variety of services and goods needed (Holechek et al., 2001).

More than half of the total area of Pakistan has been categorized as rangelands. The land, vegetation and its inhabitants, for example flora and fauna, domestic animals and rural societies experience intolerable pressure due to heavy grazing over large areas of rangelands. Increase in population, both human and livestock, are the contributing factors, which result in the expansion of dryland farming on marginal lands to satisfy the increasing need of food crops, and

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diminishing the forests for domestic energy consumption (Umrani et al., 1995). Palatable grasses are suppressed by unpalatable and low quality forage in rangelands now a days; consequently livestock face severe losses due to lack of feed in the dry spell and during famine (Grainger, 1990; Alvi and Sharif, 1995).

Competition with cash crops is continuously reducing the fodder production. The nutrient supply to ruminants is decreasing due to the rising demand of cereal grains for human consumption attached with reduction in land for fodder cultivation. Thus, there is great need to explore alternate feed resources which do not compete with human feed (Raghuvansi et al., 2007). Fodder tree leaves are alternative feed source for ruminants (Malik et al., 1967) and can help to minimize the wide gap between availability and supply of nutrients, and improve the animal growth and productivity. Fodder tree leaves are highly enriched with protein, soluble carbohydrates, minerals and vitamins, and can be used as feed (Bakshi and Wadhwa, 2007). Use of tree leaves for ruminants enhances microbial growth and digestion (Bonsi et al., 1995). Moreover, fodder tree leaves are very much liked by small ruminants especially goats.

Leguminous tree leaves have generally been given as supplement to domestic animals in Asia, Africa and the Pacific Islands. Species such as *L. leucocephala* (Ipil ipil) has been developed along with meadows in fodder pools to supply highly nutritious forage for ruminants. Legume tree leaves retain higher protein and mineral contents through development in contrast with grasses, that decrease quickly in quality with

advancement to ripeness. Legume tree foliage is then, helpful as a protein supplement. These trees are used as a good quality feed source for grazing animals now a days to increase the production. All the facts show the importance of *Leucaena* to get better animal protein and milk from grazing cattle. Additional research and knowledge through experiments time and again revealed the need to build up ways to utilize *Leucaena* most capably in profitable work and to promote farmers and grazers to use it (Clem et al., 1993).

Considering the fact that the rangelands of Pakistan are infested with low palatable species of grasses, the present study was initiated to focus on utilizing less palatable grass species as forage, adding value to relatively poor valued grasses namely *Heteropogon contortus*, *Desmotachya bipinnata*, *Sorghum halepense* and *Chrysopogon aucheri* by mixing with tree leaves of Ipil ipil on forage quality.

MATERIALS AND METHOD

These experiments were carried out at the Rangeland Research Institute, National Agricultural Research Centre (NARC), Islamabad, Pakistan at 33.42 °N; 73.08 °E. Four grasses namely, *Heteropogon contortus* (HC), *Desmotachya bipinnata* (DB), *Sorghum halepense* (SH) and *Chrysopogon aucheri* (CA) were clipped from pasture area of NARC spread over 30 acres. These grasses were harvested at their maturity stage and then chopped for making hay.

Four low palatable grasses viz., *H. contortus*, *D. bipinnata*, *S. halepense* and *C. aucheri* were mixed with tree leaves of Ipil ipil collected from NARC pasture area in the ratios

of 75:25, 50:50, 25:75 along with sole species to make different treatments. There were 3 replications in an RCBD. Samples were dried in an oven at 80 °C to a constant weight for at least 24h grinded and analyzed for crude protein, crude fibre, ash and ether extract (AOAC, 1992) at Animal Nutrition Laboratories of the Animal Sciences Institute, NARC, Islamabad. Data collected on various parameters were subjected to statistical analysis by using analysis of variance technique under completely randomized design. Means were compared by using least significant differences (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Effect of Mixing Various Levels of *H. contortus* and Ipil ipil on their Chemical Composition

The dry matter content (DM) showed significant variation among the treatments of HC and II (Table 1). The significantly highest DM content (73.97%) was recorded for the sole HC. The combination, II_{100%} showed the lowest DM content (46.22%) than the rest of treatments (Table 1). The descending trend of DM content was II_{100%} > HC_{25%} + II_{75%} > HC_{50%} + II_{50%} > HC_{75%} + II_{25%} > HC_{100%}. As the level of HC decreased in combination the DM content decreased linearly. CP value of the treatments showed significant variation ranging from 8.46% to 28.25%. The significantly highest value 28.25% was recorded in the treatment II_{100%} while lowest in HC_{100%}. As the HC level decreased in combination and II increased, CP increased linearly. Young *H. contortus* contains about 10% protein, which is reduced to 4-6% in blooming period and remains

Table 1. Chemical composition (%) of various combinations of *H. contortus* and Ipil ipil

Treatment	DM%	CP%	CF%	Ash%	EE%
HC _{100%}	73.97 ^a	8.46 ^e	35.71 ^a	6.51 ^e	1.80 ^b
HC _{75%} +II _{25%}	67.34 ^b	13.39 ^d	30.65 ^b	7.25 ^d	2.50 ^d
HC _{50%} +II _{50%}	60.42 ^c	18.33 ^c	25.70 ^c	8.17 ^e	3.20 ^c
HC _{25%} +II _{75%}	53.01 ^d	23.16 ^b	20.75 ^d	8.93 ^b	3.80 ^b
II _{100%}	46.22 ^e	28.25 ^a	15.36 ^e	9.82 ^a	4.62 ^a
LSD P _≤ 0.05	1.05	0.14	0.36	0.20	0.09
CV%	0.97	0.43	0.79	1.58	2.88

Means followed by same letters do not differ significantly at P_≤0.05

2-3% in dry period. This grass is palatable at early stages but become less palatable when get mature, it becomes unpalatable at the end of growing season and can be mixed with legumes, urea or molasses for livestock. It is non-toxic however the major problem arises due to sharp, pointed seeds that infect wool and can cause skin infections (Bielfelt, 2013).

Regarding CF values, highest contents (35.71%) were recorded in the treatment HC_{100%} followed by HC_{75%}+II_{25%} and HC_{50%}+II_{50%} giving CF values of 30.65% and 25.70%, respectively. The lowest CF content 15.36% and 20.75% were observed in the treatments II_{100%} and, HC_{25%}+II_{75%}, respectively. As the level of HC vs II decreased, CF content decreased linearly. The ash content varied significantly among the treatments ranging from 6.51% to 9.82%. The highest amount of ash was recorded in the treatment II_{100%}, followed by the treatments HC_{25%}+II_{75%} and HC_{50%}+II_{50%} giving 8.93% and 8.17% ash content respectively, with significant difference among the column. As the level of HC vs II decreased, the ash content increased linearly. Significant variations were recorded in EE content among various treatments.

The highest and lowest values of 4.62% and 1.80% were recorded in the treatments II_{100%} and HC_{100%}, respectively. As the level of HC vs II decreased, EE level increased linearly (Table 1).

Effect of Mixing Various Levels of *D. bipinnata* and Ipil ipil on their Chemical Composition

The 70.30% dry matter (DB_{100%}) was significantly highest while the lowest was recorded in II_{100%} producing 46.61% dry matter (Table 2). As the level of DB decreased in combination the DM content decreased linearly. Tahir (1996) reported that DM yield obtained from grasses was significantly higher than legumes and mixtures due to their very high fresh yield. Grasses are, in general better competitors than legumes as their strong fibrous root systems can extract nutrients from deeper layers of soil and can thus add positively to the overall primary productivity of the system (Ofori and Stern, 1989). The mean values of CP showed significant variations among the various treatments of DB and II. The II alone showed significantly highest CP yield of 28.09% while the lowest 6.73% was recorded in DB_{100%} followed by

Table 2. Chemical composition (%) of various combinations of *D. bipinnata* and Ipil ipil

Treatment	DM%	CP%	CF%	Ash%	EE%
DB _{100%}	70.30 ^a	6.73 ^e	38.04 ^a	11.60 ^a	1.78 ^e
DB _{75%} +II _{25%}	68.81 ^b	12.53 ^d	32.84 ^b	11.14 ^b	2.37 ^d
DB _{50%} +II _{50%}	61.40 ^c	17.15 ^c	31.52 ^c	10.63 ^c	2.93 ^c
DB _{25%} +II _{75%}	54.24 ^d	23.02 ^b	21.81 ^d	10.27 ^d	3.45 ^b
II _{100%}	46.61 ^e	28.09 ^a	15.74 ^e	9.78 ^e	4.12 ^a
LSD P _≤ 0.05	0.60	0.41	0.07	0.06	0.10
CV%	0.54	1.31	0.15	0.32	3.24

Means followed by different letters are statistically different from each other at P_≤ 0.05

DB_{25%}+II_{75%}, with 23.02% having highly statistical difference. As the DB level decreased in combination and II increased, CP increased linearly.

Significantly highest CF content of 38.04% was observed in the treatment where only DB_{100%} was analyzed and the lowest CF of 15.74% from II_{100%}. Trend of increase in CF content among the various treatments was DB_{100%} > DB_{75%}+II_{25%} > DB_{50%}+II_{50%} > DB_{25%}+II_{75%} > II_{100%}. As the level of DB vs II decreased, CF content decreased linearly. The ash content varied among various combinations of DB and II. The DB alone showed significantly highest content of 11.60% followed by DB_{75%}+II_{25%}, DB_{50%}+II_{50%} and DB_{25%}+II_{75%} by producing 11.14%, 10.63% and 10.27%, respectively, with highly significant difference. The lowest ash content (9.78%) was recorded in II_{100%}. As the level of DB vs II increased, the ash content increased linearly. Various treatments showed significant effect on EE content. The EE content ranging from 1.78% to 4.12% among the treatments was observed. The highest value of EE (4.12%) was recorded in treatment II_{100%}, followed by treatment DB_{75%}+II_{25%} producing 2.37% EE. The lowest EE content (1.78%) was obtained from treatment DB_{100%}, followed by treatments DB_{50%}+II_{50%}, and DB_{25%}+II_{75%} producing 2.93 and 3.45%, respectively. As the level of DB vs II decreased, EE level increased linearly.

Effect of Mixing Various Levels of *S. halepense* and Ipil ipil on their Chemical Composition

The variation in dry matter (DM) values was statistically significant.

The highest mean value of DM (74.65%) was recorded in treatment SH_{100%}, followed by 68.16%, 64.18% and 54.56% in treatments SH_{75%}+II_{25%}, SH_{50%}+II_{50%} and SH_{25%}+II_{75%} with highly significant difference (Table 3). The lowest value of DM (46.82%) was recorded in treatment II_{100%}. As the level of SH decreased in combination the DM content decreased linearly.

It is evident that the significantly highest CP content of 30.72% was observed in the treatment where only II_{100%} was analyzed and the lowest CP of 7.62% from SH_{100%}. The trend of increase in CP content among the various treatments was II_{100%} > SH_{25%}+II_{75%} > SH_{50%}+II_{50%} > SH_{75%}+II_{25%} > SH_{100%}. As the SH level decreased in combination and II increased, CP increased linearly.

The highest CF value of 36.59% was recorded in SH_{100%} while the lowest 18.28% was in II_{100%} (Table 3). Among the various combinations of SH and II, the treatment of SH_{75%}+II_{25%} remained inferior by producing 32.78% CF content. The trend of increased CF content among the treatments remained SH_{100%} > SH_{75%}+II_{25%} > SH_{50%}+II_{50%} > SH_{25%}+II_{75%} > II_{100%}. As the level of SH vs II decreased, CF

content decreased linearly. The ash content of the treatments varied significantly among the various combinations of SH and II. The highest ash content of 9.73% and 8.9% was recorded in the treatment II_{100%} and SH_{25%}+II_{75%} with highly statistical difference among them. The lowest content (6.85%) of ash was recorded in treatment SH_{100%}. The trend of increased ash content among the treatments remained II_{100%} > SH_{25%}+II_{75%} > SH_{50%}+II_{50%} > SH_{75%}+II_{25%} > SH_{100%}. As the level of SH vs II decreased, the ash content increased linearly.

Various treatments of the experiment showed significant effect on the EE content. The EE content ranged from 1.76% to 3.17% among the treatments. The highest content of 3.17% was recorded in treatment II_{100%}. The lowest content of 1.76% EE was recorded in treatment SH_{100%} showing significant difference among treatments. As the level of SH vs II decreased, EE level increased linearly (Table 3).

The leaves of Ipil ipil mixed with less palatable grasses give a productive outcome when fed to livestock. Protein content can be attributed to their ability to fix atmospheric nitrogen due to *Rhizobium* strains, in their root nodules. Such legumes can be grown in soils depleted of nitrogen without the application of nitrogenous fertilizer and hopefully also without further reducing the overall nitrogen reserve of the soils given that an adequate amount of biomass is replaced in the soil after cropping. The total amount of biological fixed nitrogen has been estimated globally to be 138-170 m t yr⁻¹, yet this amount is very small fraction of total nitrogen reservoir of 105,000 m t in the soil (Paul, 1988).

Table 3. Chemical composition (%) of various combinations of *S. halepense* and Ipil ipil

Treatment	DM%	CP%	CF%	ASH%	EE%
SH _{100%}	74.65 ^a	7.62 ^e	36.59 ^a	6.85 ^e	1.76 ^c
SH _{75%} +II _{25%}	68.16 ^b	12.61 ^d	32.78 ^b	7.50 ^d	2.00 ^d
SH _{50%} +II _{50%}	64.18 ^c	20.15 ^c	27.62 ^c	8.20 ^c	2.43 ^c
SH _{25%} +II _{75%}	54.56 ^d	24.07 ^b	22.62 ^d	8.90 ^b	2.70 ^b
II _{100%}	46.82 ^e	30.72 ^a	18.28 ^e	9.73 ^a	3.17 ^a
LSD P≤ 0.05	0.32	0.14	0.37	0.22	0.27
CV%	0.31	0.41	0.76	1.47	10.32

Means followed by different letters are statistically different from each other at P≤ 0.05

Moreover in areas under arable cultivation, symbiotic biological nitrogen fixation by legumes is the dominant source of nitrogen input often being greater than 80% of the total N fixed in the system (Fujita et al., 2014).

Effect of Mixing Various Levels of *C. aucheri* and *L. leucocephala* on their Chemical Composition

The DM % of various treatments varied significantly with the combination of CA and II at various ratios. The highest content of DM (75.45%) was recorded in the treatment CA_{100%}, the lowest (47.22%) in II_{100%} (Table 4). As the level of CA decreased in combination the DM content decreased linearly. The CP content ranged from 5.70% to 26.48% with statistically high differences among them. The highest value of CP 26.48% was recorded in the treatment II_{100%}, followed by the treatment CA_{25%}+II_{75%} producing 22.43% CP. As the CA level decreased in combination and II increased, CP increased linearly.

The highest CF (38.79%) content was recorded for the treatment CA_{100%} while lowest (13.84%) in II_{100%}. As the level of CA vs II decreased, CF content

decreased linearly. The statistically highest ash content of 8.80%, 8.10% and 7.53% was produced from treatments II_{100%}, CA_{25%}+II_{75%} and CA_{50%}+II_{50%}, respectively (Table 4). As the level of CA vs II decreased, the ash content increased linearly. The ether extract (EE) content varied significantly with the variation in combinations of CA and II. The lowest EE of 0.35% was recorded in CA_{100%}, while the highest of 3.80% from II_{100%}. As the level of SH vs II decreased, EE level increased linearly (Table 4).

Many researchers had recognized for a long time that Ipil ipil (*L. leucocephala*) plays a vital role in the improvement of cattle production. Many experiments carried out at University of Hawaii during 1930s, illustrated the importance of *Leucaena* towards dairy and beef cattle (Henke, 1933). New research has shown that better breed of cattle can increase 1 kg weight every day if provided with 100% mixture of *Leucaena*, rich in protein for at least three months before slaughtering. It holds 30-32% protein in the leaves of a superior variety on dry weight basis. Without any illness or bad influence livestock can eat *Leucaena* up to 4 months, which is a perfect time for fattening of livestock before slaughtering (Hutton, 1974). As *Leucaena* contains a toxic compound called mimosine, which causes thyroid problems and some other injurious affects when fed to livestock for a long period, this toxic effect can be removed with the addition of grass (Brewbaker, 1976). Palatable species are suppressed by unpalatable and low quality forage in rangelands, consequently livestock has faced severe losses due to lack of feed in the dry phase and during low

Table 4. Chemical composition (%) of various combinations of *C. aucheri* and Ipil ipil

Treatment	DM%	CP%	CF%	ASH%	EE%
CA _{100%}	75.45 ^a	5.70 ^e	38.79 ^a	6.33 ^a	0.35 ^e
CA _{75%} +II _{25%}	69.95 ^b	11.31 ^d	32.11 ^b	6.96 ^b	2.10 ^d
CA _{50%} +II _{50%}	62.81 ^c	16.41 ^c	25.54 ^c	7.53 ^c	2.08 ^c
CA _{25%} +II _{75%}	55.14 ^d	22.43 ^b	20.87 ^d	8.10 ^d	2.84 ^b
II _{100%}	47.22 ^e	26.48 ^a	13.84 ^e	8.80 ^e	3.80 ^a
LSD P≤ 0.05	0.34	0.45	0.46	0.33	0.19
CV%	0.30	1.52	0.97	3.80	9.60

Means followed by different letters are statistically different from each other at P≤ 0.05

forage available (Grainger, 1990; Alvi and Sharif, 1995).

Grass-legume mixture are preferred over pure-grass forage throughout the world because they often improve the herbage quality especially the crude protein content and offer balanced nutrition. Mixture offer several potential advantages over pure grasses or pure legumes including disease break and weed control. The result of the present study also demonstrated that low palatable grass of *Heteropogon contortus* if mixed with leguminous tree leaves of Iple Iple not only improved forage quality but also enhance palatability.

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