EFFECT OF MIXING LOW PALATABLE GRASS OF *HETEROPOGON CONTORTUS* WITH IPIL IPIL LEAVES ON DIGESTIBILITY IN GOATS

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ABSTRACT:- The study was conducted at the National Agricultural Research Centre, Islamabad, Pakistan during 2012 to find out the effect of mixing low palatable grasses of *Heteropogon contortus* (HC), with tree leaves of *Leucaena leucocephala* (Ipil ipil, II) in the ratio of 75:25, 50:50, 25:75, along with sole species on their digestibility in small ruminants. Goats fed $II_{100\%}$, $HC_{25\%}$ $II_{75\%}$, $HC_{50\%}$ $II_{50\%}$, $HC_{75\%}$ $II_{25\%}$ and $HC_{100\%}$ had similar dry matter (DM), crude protein (CP) and crude fibre (CF) consumption among all the treatments. The digestibility percentage of dry matter intake (DMI) varied among the treatments ranging from 68.25% to 41.66%. Mixtures of low palatable grass and Ipil ipil were in general more digestible with more than 65% dry matter digestibility. The lowest digestibility of dry matter (41.66%) was observed in HC 100%. A similar trend was noted for CP digestibility. However, reverse trend was observed in digestibility of CF where highest digestibility was recorded in $HC_{100\%}$ and lowest in $II_{100\%}$. It can be concluded that grass and ipil ipil leaf mixture are better regarding forage quality and nutrient digestibility and can be recommended as animal feed.

Key Words: Low Palatable Grass; Heteropogon contortus; Leucaena leucocephala; Ipil ipil; Consumption; Goats; Digestibility; Dry Matter; Crude Protein; Crude Fibre; Pakistan.

INTRODUCTION

For the survival of human race, rangelands play a vital role in providing a variety of services and goods needed (Holechek, 1984). Overgrazing of rangeland flora and ruthless cutting of trees has reduced the forage production capacity of our rangelands. Now, it is imperative to restore their forage potential by growing highly palatable productive forage species in this vast natural resource of the country (Butt and Ahmad, 1994). Pakistan has a wealth of 163.2 million heads of livestock which contribute up to 11.50 % to the GDP (GoP, 2010). Rangelands are important in fulfilling the nutritional requirements of livestock along with fodder crops and agro-industrial wastes. Therefore, the sustainable use of rangelands is vital for providing forage to livestock for the development of national economy. Currently, overgrazing of rangelands, depletion of vegetation cover, shortage of forage and fodder resources and poor livelihood of pastoral communities are some of the major issues and problems for the food security in the country (Afzal and Ullah, 2007). This

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has resulted in increased frequency and cover of unpalatable grasses. It is of paramount importance that high yielding and palatable grass species should be established in their suitable eco-sites (Mohammad and Naqvi, 1987).

In many rangelands scenescence commences in the herbaceous vegetation early in the grazing season and its palatability and nutritive value reduced so rapidly that within a few weeks it is incapable of supporting animal maintenance requirements (Nastis, 1983). In contrast shrubby species contain sufficient protein and phosphorus for maintenance throughout most of the grazing season (Holecheck, 1984) and their introduction even into *Agropyron desertorum* pasture improves overall forage quality (Otsyina et al., 1980). Their presence also modifies the micro-climate which increases vegetation production and quality (Forti, 1971).

Livestock plays a vital role in economy uplift of any state; its main products are milk and meat. The contribution of livestock towards agriculture is 53.2% and towards national GDP is 11.4% (GoP, 2010). During 2009-10 an increased proportion in livestock sector was observed while other development sectors have shown comparatively downfall trend. Cost of gross value addition of livestock was Rs. 1304.6 billion (2008-09) which has increased to Rs. 1537.5 billion i.e., 17.8% in 2009-10. The importance of livestock and its product is increasing day by day with the gradual increase in population and per capita income (GoP, 2010).

Heavy grazing over vast areas of rangelands has steadily put unbearable pressures on land, vegetation, and its inhabitants, such as wildlife, livestock and pastoral communities. The main causative factor is increase in human and livestock population. This has led to an extension of dry land farming on marginal lands to satisfy the rising demand for food crops, and the cutting of shrubs and trees for domestic fuel consumption (Umrani et al., 1995). As a result, the palatable species that previously covered the rangelands have been destroyed or thinned out, and it is now dominated by unpalatable low quality vegetation. Therefore every year, insufficient forage during the dry period, collective with drought years, causes serious losses of livestock (Grainger, 1990; Alvi and Sharif, 1995).

The rangelands of Pakistan are infested with less palatable species of grasses. Therefore, the present study was initiated to focus on utilizing less palatable grass species as forage, adding value to relatively poor valued forages and make them palatable and consumable for feed deficient periods. The study was conducted to find out digestibility of mixed less palatable grass H*eteropogon contortus* (HC) with Ipil ipil (II).

MATERIALS AND METHOD

The study was conducted at the National Agricultural Research Centre, Islamabad. A low palatable grass, *Heteropogon contortus* (HC), was clipped from pasture area of NARC at the pre flowering stage and then chopped for making hay. The dried grass was mixed with the leaves of *Leucaena leucocephala* (Ipil ipil, II) in the ratios of 75:25, 50:50, 25:75 and sole species to make different treatments. There were three replications for each treatment. Samples were dried in an oven at 80°C to a constant weight for at least 24 h, grounded and analyzed for proximate parameters.

Digestibility Trial

Fifteen mature beetle goats were used to determine the nutrients digestibility of less palatable grasses and iple iple. Typical method of total feces collection was used to carry out digestion trial. Experimental animals were kept in individual crates, fitted with arrangement to collect feces and had free access to water. Two meals of equal sizes at 0900h and 1830h were offered to each goat and daily feed intakes were individually recorded.

Each trial included a 10 days adaptation period and 5 days collection period. Daily feed offered, total feces and feed refusal were individually recorded. The collected feces were carefully mixed and then 10% of the total samples were used to dry at 80°C for 24h. Afterwards, these samples were grounded and then analyzed for crude protein (CP), ash content, ether extract (EE) and crude fiber (CP) of feed offered, feed refused and feces were determined in Animal Nutrition Lab, ASI, NARC (AOAC, 1992) and on that basis digestibility was calculated.

Digestibility % = intake – outgo / intake *100

Data collected on various parameters were subjected to statistical analysis by using analysis of variance technique under completely randomized design. Means of different parameters were tested by using least significant differences (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Chemical Composition (%) in Animal Feces

The dry matter (DM) varied significantly among the treatments ranging from 74.00% to 74.80% (Table 1). The highest content of DM (74.80%) was recorded in the treatment $II_{100\%}$, followed by treatment $HC_{50\%}$ + $II_{50\%}$ giving 74.47% dry matter content with non- significant difference. The lowest DM content of 74.00% and 74.07% was recorded in treatments $HC_{75\%}$ + $II_{25\%}$ and $HC_{25\%}$ + $II_{75\%}$ respectively, having no statistical difference.

The CP data showed significant variations among the treatments. The significantly highest value of 13.16% was recorded in the treatment $HC_{25\%}$ + $II_{75\%}$ (Table 1). The second highest value of CP content of feces was recorded in treatment $HC_{75\%}$ $II_{25\%}$ was 10.33% which was at par with the highest value of 13.16% observed for treatment $HC_{25\%}$ + $II_{75\%}$. The lowest CP content of 6.39% was observed from treatment $HC_{100\%}$, followed by treatments $II_{100\%}$ and $HC_{50\%}$ + $II_{50\%}$ producing 10.31% and 10.32% and showing non-significant difference among each other.

The CF content of the treatments varied significantly by the various combinations of HC and II. The highest CF content of 26.42% was recorded in the treatment $II_{100\%}$, followed by $HC_{75\%}$ + $II_{25\%}$ and $HC_{50\%}$ + $II_{50\%}$ producing same value of 24.68% with no statistical difference (Table 1). However, lowest value of CF (23.43%) was recorded in treatment $HC_{25\%}$ + $II_{75\%}$. The descending trend of CF content among the treatments

Table 1. Chemical analysis of animal feces (%)

Treatments	DM	CP	CF	Ash
$II_{100\%}$	74.80[a]	10.31[b]	26.42[a]	12.77[ab]
$HC_{25\%}$ $II_{75\%}$	74.07[c]	13.16[a]	23.43[b]	13.42[a]
$HC_{50\%}$ $II_{50\%}$	74.47[ab]	10.32[b]	24.68[ab]	12.07[b]
$HC_{75\%}$ $II_{25\%}$	74.00[c]	10.33[b]	24.68[ab]	12.71[ab]
$HC_{100\%}$	74.21[bc]	6.39[c]	24.60[b]	12.96[ab]
LSD $P\leq 0.05$	0.46	1.81	1.8	0.9
CV%	0.53	16.8	7.64	7.34

Means followed by same letters do not differ significantly at $P\leq 0.05$

remained $HC_{25\%}$ $II_{75\%}$ > $HC_{100\%}$ > $HC_{50\%}$ $II_{50\%}$ > $HC_{75\%}$ $II_{25\%}$ > $II_{100\%}$.

The ash content of the treatments varied significantly ranging from 12.07% to 13.42% (Table 1). The highest value of 13.42% was recorded in the treatment $HC_{25\%}$ + $II_{75\%}$ while the lowest, (12.07%) in treatment $HC_{50\%}$ + $II_{50\%}$. All the combinations were statistically at par except for the treatment $HC_{50\%}$ + $II_{50\%}$. The trend of increase in Ash% was $HC_{25\%}$ $II_{75\%}$ > $HC_{100\%}$ > $II_{100\%}$ > $HC_{75\%}$ $II_{25\%}$ > $HC_{50\%}$ $II_{50\%}$.

Average Daily Intake of DM, CP and CF of Goats and their Digestibility

The dry matter intake (DMI) showed significant variation among the treatments (Table 2). The significantly highest DMI value (4.18 kg) was recorded in the treatment $HC_{25\%}$ + $II_{75\%}$ followed by $HC_{50\%}$ + $II_{50\%}$ (3.99 kg) with no statistical difference. The DMI of 3.99, 3.80, and 3.75 kg were observed in the treatments $HC_{50\%}$ + $II_{50\%}$, $HC_{75\%}$ + $II_{25\%}$ and $II_{100\%}$, respectively, with non-significant differences among them. The $HC_{100\%}$ showed the lowest DMI value (1.60 kg) than the rest of treatments. The ascending trend of DMI content was 1.60, 3.75, 3.80, 3.99 and 4.18 kg. The digestibility percentage of DMI varied among the treatments ranging from 68.25% to 41.66%. The highest value of dry matter digestibility (68.25%) was recorded in the treatment $HC_{25\%}$ + $II_{75\%}$, while the lowest (41.66%) in treatment $HC_{100\%}$. There was no statistical difference among the treatments apart from treatment $HC_{100\%}$. As the level of II and HC decreased, DMI as well as digestibility linearly decreased.

As evident from data, the significantly highest CPI of 1.05 kg was recorded in the treatment $II_{100\%}$, while the lowest CPI of 0.12 kg from $HC_{100\%}$ (Table 2). The second highest CPI was recorded in treatment $HC_{25\%}$ + $II_{75\%}$ by intaking 0.83 kg followed by treatment $HC_{50\%}$ + $II_{50\%}$ with 0.76 kg which were statistically different from each other. The trend of increase in CPI among various treatments was 1.05 > 0.83 > 0.76 > 0.39 and 0.12 for the treatments $II_{100\%}$ > $HC_{25\%}$ $II_{75\%}$ > $HC_{50\%}$ $II_{50\%}$ > $HC_{75\%}$ $II_{25\%}$ > $HC_{100\%}$, respectively. The digestibility percentage of CPI was 77.00%, 72.33% and 70.66% in the treatments $II_{100\%}$, $HC_{25\%}$ + $II_{75\%}$ and $HC_{50\%}$ + $II_{50\%}$, respectively, showing non-statistical difference among the treatments. The treatment $HC_{75\%}$ + $II_{25\%}$ had CPI digestibility percentage of 68.33%, statistically apart from rest of the treatments. However, the lowest crude protein digestibility 41.11% was recorded in treatment $HC_{100\%}$. The trend of increase in digestibility percentage for CPI was denoted as $II_{100\%}$ > $HC_{25\%}$+ $II_{75\%}$ > $HC_{50\%}$ $II_{50\%}$ > $HC_{75\%}$ $II_{25\%}$ > $HC_{100\%}$. As the level of II vs HC decreased, CPI as well as digestibility decreased linearly.

Various treatments of the experiment showed significant effect on CFI content. The CFI content ranged from 0.56 to 0.85 kg among the treat-

Table 2. Intake and digestibility of DM, CP and CF (%)

(%)

Treatments	DMI (kg)	DM Digestibility (%)	CPI (kg)	CP Digestibility (%)	CFI (kg)	CF Digestibility (%)
$II_{100\%}$	3.75^{b}	66.62^{a}	1.05^{a}	77.00^{a}	0.56^{b}	40.0^{c}
$HC_{25\%}\ II_{75\%}$	4.18^{a}	68.25^{a}	0.83^{b}	72.33^{a}	0.58^{b}	41.6^{c}
$HC_{50\%}\ II_{50\%}$	3.99^{ab}	67.45^{a}	0.76^{c}	70.66^{a}	0.85^{a}	47.0^{b}
$HC_{75\%}\ II_{25\%}$	3.80^{b}	67.25^{a}	0.39^{d}	68.33^{b}	0.79^{a}	46.3^{b}
$HC_{100\%}$	1.60^{c}	41.66^{b}	0.12^{e}	41.11^{c}	0.56^{b}	60.0^{a}
LSD $P\leq 0.05$	0.36	9.64	0.04	7.01	0.11	4.35
CV%	5.79	6.44	4.05	4.65	9.76	2.88

Means followed by same letters do not differ significantly at $P\leq 0.05$

ments. The highest value of CFI, 0.85 kg was recorded in treatments $HC_{50\%}$+ $II_{50\%}$, followed by treatment $HC_{75\%}$ + $II_{25\%}$ producing 0.79 kg CFI, respectively, with no statistical difference. The lowest CFI of 0.56 kg was obtained from treatment $HC_{100\%}$, followed by treatment $HC_{25\%}$ $II_{75\%}$, and $II_{100\%}$ giving 0.58 and 0.56 kg CFI content having no statistical difference. The highest value of 60.0% digestibility was recorded in the treatment $HC_{100\%}$ followed by $HC_{50\%}$ + $II_{50\%}$ and $HC_{75\%}$+ $II_{25\%}$ with 47.0% and 46.3%, respectively. The statistical lowest digestibility values of 40.0% and 41.6% were recorded in the treatments $II_{100\%}$ and $HC_{25\%}$ +$II_{75\%}$, respectively.

Feeding value of forage quality is dependent on total digestible nutrients and percentage of crude protein. The highly important aspect in the feed of rumens is amount of crude protein present, which helps to increase milk and meat production and keeping livestock assets (Afzal and Ullah, 2007). Quality analysis of the fodder samples for percent ash, crude protein (CP) and In-Vitro Dry Matter Digestibility (IVDMD) are the measures of nutritive parameters such as total protein (TP) and total digestible nutrients (TDN) available from the fodder. Legumes have highest values for percent ash, CP and IVDMD (Tahir, 1996). Most important parameter to assess the nutritive value of fodder is protein content, which is significantly higher in mixtures than in grasses alone. Foster et al. (2014) reported that forage mixtures of legumes and non legumes gave better combination of quality fodder having more protein yield. Among the treatments II gave significantly highest CP followed by $HC_{25\%}$+ $II_{75\%}$, $HC_{50\%}$ $II_{50\%}$, $HC_{75\%}$ $II_{25\%}$ and $HC_{100\%}$, respectively (Table 2). Oats-legume mixture produced the highest (10.73 t ha^{-1}) TDN followed by lolium-legume. Similar results are reported by Shoaib et al. (2013), that oat and barley legume intercrop gave more digestible DM than their pure stands.

The II leaves 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. Biological nitrogen fixation by the legumes has been seen as an alternative to the use of nitrogenous fertilizers in farming systems as most agricultural forage legumes contain 2-4% nitrogen in their biomass (Qamar, 1997). 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.

Goats fed $II_{100\%}$, $HC_{25\%}$ $II_{75\%}$, $HC_{50\%}$ $II_{50\%}$, $HC_{75\%}$ $II_{25\%}$, $HC_{100\%}$ had similar DM, CP and CF consumption among all the treatments. The highest digestibility of DM (61.01%) in animals was recorded in treatment $HC_{75\%}$ $II_{25\%}$, followed by 60.80% and 60.48% in treatments $HC_{100\%}$ and $HC_{50\%}$ $II_{50\%}$ but the differences were non-significant among the treatments. The lowest digestibility of dry matter (51.14%) was observed in $II_{100\%}$. A similar trend was noted for CF digestibility. Similarly, differences in the digestibility of CP among all the treatments were non-significant.

It can thus be concluded from the present study that mixture of low palatable grasses and legumes is the best way to incorporate low palatable grasses into the existing feeds thus enhancing the livestock production in the country.

LITERATURE CITED

Afzal, J. and M.A. Ullah. 2007. Assessment of productive potential and utilization of rangelands and sown pastures in Pothowar Plateau. National Agricultural Research Centre, Islamabad, Pakistan. 10 p.

Alvi, A.S. and M. Sharif. 1995. Arid zone agriculture and research in Pakistan. Progressive Farming, 15: 5-12.

AOAC. 1992. Official Methods of Analysis. Association of Analytical Chemists Arlington. Virginia, USA. 15th edn. 635 p.

Butt, N.M. and M. Ahmed. 1994. Production and Management of Buffel grass pasture. Progressive Farming, 14: 30-32.

Forti, M. 1971. Introduction of forage shrubs and their evaluation for use in semiarid areas of North-western Negev Division of Life Sciences. Negev Institute for arid zone Research, Beer Shiva, Israel. p. 12.

Foster, A., C. Vera, S. Malhi and F. Clarke. 2014. Forage yield of simple and complex grass–legume mixtures under two management strategies. Can. J. Pl. Sci. 94(1): 41-50.

GoP, 2010. Economic survey of Pakistan, Ministry of Food, Agriculture and Livestock, Government of Pakistan, Islamabad.

Grainger, A. 1990. The threatening desert. Earthscan publication Ltd. London. 369 p.

Holechek, J.L. 1984. Comparative contribution of grasses, forbs and shrubs to the nutrition of range ungulates. Rangelands, 6(6): 261-263.

Mohammad, N. and A.H. Naqvi. 1987. Dry matter yield of promising grasses in tropical arid rangelands of Sind, Pakistan. Tropical Agric. 61: 70-71.

Nastis, A.S. 1982. Nutritive value of oak browse (*Quercus coccifera*) foliage for goats at various phenological stages (in Greek). Aristotelian University of Thessaloniki, Greece. p. 60.

Otsyina, R., C. McKell, V. Epps and I.J. Gordon. 1980. Fodder shrubs and crested wheatgrass proportions to meet nutrient requirements of livestock for fall and early grazing. Abstract of paper presented at 33rd Annual meeting of the Society for Range Management.

Qamar, I.A. 1997. The effect of defoliation of vetch, barley and their mixtures on forage yield, quality and residual effects on succeeding crops in the rainfed areas of Pakistan. Ph.D. Thesis. Department of Agriculture, University of Reading, UK. 128 p.

Shoaib, M., M. Ayub, M.S. Zamir and M.J. Akhtar. 2013. Dry matter yield of oat-Egyptian clover mixture under varying proportions and different growth stages of oat. Intern. J. Agric. and Biol. 15: 673-679.

Steel, R. and J. Torrie. 1984. Principles and procedures of statistics: A biometrical approach. 3rd edn. McGraw-Hill, New York, USA. 633 p.

Tahir, S. 1996. Production potential and nutritive values of winter season fodder of irrigated farms. Report on Cereal Crops Research Institute (CCRI), Pirsabak, Nowshera. 10 p.

Umrani, A.P., P.R. English and D. Younie. 1995. Range lands in Pakistan. Asian Livestock, Bangkok, Thailand. 3: 30-36.

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