INTRODUCTION

Ruminants can rely exclusively on forages as their major feed resource; hence, fodder crops have received vital importance in livestock production. In developing countries due to urbanization and trend of agriculture towards cash crops there is insufficient fodder available and animals are deficient in essential nutrients. Moreover, it is well documented that the performance of ruminants depends upon their ability to consume and digest fibrous portion of the diet (Sarwar and Iqbal, 2002).

In south East Asian sub-continent, poor inputs, low genetics potential of fodder varieties, lack of agriculture research and extension services and orthodox agronomic practices leads to low production per acre and lower the quality of fodders. These facts forced for immediate remedies like introduction to high yielding, multi-cut and improved fodder varieties. Under these circumstances efficient utilization of existing feed resources can be an important gizmo to conduit the fissure between nutrients demand and requirements.

For efficient utilization, nutritive illustration of local fodders is required to be used as base line data. Among local fodders, maize (Zea Mays) is of vital significance as it is cultivated on large scale for fodder production. Although wheat, cotton and rice are cultivated at large scale in Pakistan but maize still is the 4th important grown crop. It is cultivated over one-million-hectare area at about 4.0 million metric tons valuable food production (Anonymous, 2010). It is highly palatable and plays an immense part in fattening of livestock. The quantity and quality of maize fodder is exceptionally variable depending upon variety, ago-chemical conditions and management factors. One of the major and vital factors affecting the nutritive value of maize is the choice of harvest time and physiological maturity of crop at harvest (Cherney et al., 1993, Harrison et al., 1996). While, the nutritive value may also differ among varieties of the same fodder (Estrada-Flores et al.,...
So, its utilization can be improved by perception of fodder harvest stage with minimum lignification and maximum DM content and the appropriate variety suitable for ruminant feeding.

Limited scientific information is available on the issue; hence, the existing experiment was planned to establish the feeding value of three maize fodder varieties harvested at 40 and 60 days of maturity and their breakdown kinetics in rumen cannulated Nili Ravi buffalo bulls in situ.

MATERIALS AND METHODS

Three buffalo bulls fitted with rumen cannula were used to evaluate maize varieties Sa 2000, Gl 2000 and Sa 2001, harvested at 40 and 60 days of age. Maize fodder was offered to cannulated bulls to avoid any variation due to feed on rumen fermentation pattern. Same feed was given to animals for 10 days as an adaptation prior to incubation of samples in nylon bags for 4 days. Chopped fodder samples were dried in hot air oven at 60°C and ground to 2mm mash size for analysis of dry matter (DM), CP, ether extract (EE) and total Ash (AOAC, 1995), Neutral Detergent Fiber (NDF), Acid detergent fiber (ADF) and Acid detergent lignin (ADL) by the methods of (Van. Soest et al., 1991). Ten-gram sample of each variety was taken separately in nylon bags measuring 10×23cm having pore size of 50µm for incubation in the rumen. Bags clipped with nylon thread were placed separately in the rumen for 1, 2, 4, 6, 10, 16, 24, 36, 48 and 96 hours (in triplicate for each interval; 2 bags replicate and 3rd blank). Nylon bags were placed in the distilled water at room temperature for 10 minutes before incubation into the rumen (Sarwar and Nisa, 1999). Nylon bags were placed in the rumen in converse arrangement to remove at a same time (Sarwar et al., 1995). Bags were washed in running tap water until the rinse was clear. After washing till clear rinse, bags were placed in hot air oven at 60°C for drying till constant weight. The residual materials were analyzed for DM and NDF fractions. Digestion coefficient of DM and NDF was calculated at 48 hours of incubation. Disappearance rate, lag per hour and extent of degradation of DM and NDF were investigated by the procedures defined by Sarwar et al. (1991).

STATISTICAL ANALYSIS

The data for lag time, rate and extent of DM and NDF digestion were analyzed according to Completely Randomized Design through 2x3 factorial design. Following statistical model used for data analysis;

\[ Y_{ijk} = \mu + \alpha_j + \beta_k + (\alpha\beta)_{jk} + \epsilon_{ijk} \]

In this equation, \( \mu \) was overall mean, \( \alpha \) represents varieties effect (3 varieties), \( \beta \) represents harvest period (40 and 60 days), \( (\alpha\beta) \) denotes the interactions amongst \( \alpha \) and \( \beta \) and \( \epsilon \) was the variance within means (error term). Duncan's Multiple Range test was applied to estimate extent of significance (p<0.05) across means (Steel et al., 1997).

RESULTS

CHEMICAL COMPOSITION

Chemical composition of maize verities harvested at 40 and 60 days is presented in Table 1. Dry matter and fiber fractions augmented but protein content reduced with advancing stage of harvest.

### Table 1: Chemical composition of different maize verities harvested at different growth stages.

| Parameters                  | Gl2000       | Sa2000       | Sa2001       |
|-----------------------------|--------------|--------------|--------------|
| Dry matter, %               |              |              |              |
| 40 days                     | 20.00        | 20.00        | 20.00        |
| 60 days                     | 28.00        | 28.20        | 28.00        |
| Crude protein, %            | 8.40         | 8.10         | 8.00         |
| 40 days                     | 6.90         | 6.40         | 6.60         |
| 60 days                     | 8.10         | 6.40         | 6.60         |
| Neutral detergent fiber, %  | 67.00        | 68.00        | 67.00        |
| 40 days                     | 76.50        | 75.90        | 75.00        |
| 60 days                     | 68.00        | 75.90        | 75.00        |
| Acid detergent fiber, %     | 43.00        | 42.10        | 42.00        |
| 40 days                     | 49.80        | 49.50        | 48.50        |
| 60 days                     | 49.80        | 49.50        | 48.50        |
| Acid detergent lignin, %    | 7.00         | 7.40         | 7.00         |
| 40 days                     | 8.95         | 9.52         | 9.57         |
| 60 days                     | 8.95         | 9.52         | 9.57         |
| Cellulose, %                | 36.00        | 34.75        | 39.98        |
| 40 days                     | 40.85        | 34.75        | 39.98        |
| 60 days                     | 40.85        | 34.75        | 39.98        |
| Hemicellulose, %            | 24.00        | 25.90        | 25.00        |
| 40 days                     | 26.70        | 26.40        | 26.50        |
| 60 days                     | 26.70        | 26.40        | 26.50        |

IN SITU DM AND NDF DEGRADABILITY

Table 2 illustrates that variety and harvesting stage had significant effect on in Situ DM degradability (at 48 hours of incubation) and extent of degradation (at 96 hours to incubation) of different varieties of maize fodder. The interaction between harvest stage and variety was also significant statistically (Table 2). All parameters (DM and NDF degradability, rate of degradation, lag and extent of degradation) were significantly affected by variety of the maize fodder (Tables 2 and 3). Stage of harvest of maize varieties linearly (p<0.05) effected DMD and DM extent of degradation in situ (Tables 2 and 4). In Situ Dry matter degradability (DMD,%) at 48 hours of incubation of different varieties of maize (66.99, 66.33 and 66.85%, respectively)
were higher (p<0.05) when harvested at 40 days of maturity than those (55.71, 56.64 and 58.43, respectively) harvested at 60 days of maturity (Table 2). Neutral Detergent Fiber degradability (NDFD) in different varieties of maize harvested at 40 days of maturity were higher (p<0.05) than those harvested at 60 days of maturity (Table 2). Similar trend was also observed for rate and extent of NDFD for all the varieties in the current study. Lag time (hour) of NDF exhibited an opposite trend as was perceived in rate and extent of NDF degradation for all treatments. The linear trend was observed with respect to harvest stage for all parameters of in situ experimentation (Table 4).

The effect of variety was similar for DM rate of degradation and lag time while NDF degradability, rate, lag and extent of degradation were similar (p>0.05; Table 2). Whilst, the effect of variety was linear in case of DMD and extent of degradation (Table 3). Lag time (hour) showed reverse tendency like it was observed in rate of degradation and extent of digestibility across all treatments.

**DISCUSSION**

**CHEMICAL COMPOSITION**

Dry matter and fiber fractions increased but CP content decreased with advancing age of maturity. This increase in fiber fractions and reduction in CP contents with advancing maturity was ascribed a decline in ratio between leaf and stem along with the rate of accretion of structural elements (Messam et al., 1991). Kim et al. (1989) reported increased NDF from 51.9 to 59%, ADF from 30.6 to 39.7% and ADL from 7.2 to 14.6% with advancing plant age. Boddroff and Ocumpangh (Boddroff and Ocumpangh, 1986) reported similar trend in the growth of fibrous fractions of the Mott grass when harvested at varying growth stages. Neutral detergent fiber increased from 40 to 65%, ADF from 20
to 38% while CP contents decreased from 13 to 10.5% in ryegrass (Lolium Multiflorum) as plant age progressed (Cherney et al., 1993). The reason for low CP content of soft dough stage was that with increasing maturity, cell content decreased and cell wall contents increased (Acosta et al., 1991).

**Table 4: In Situ DM and NDF Digestion Kinetics of maize harvested at 40 and 60 days.**

| Parameters                      | Harvest | SE | Linear   |
|---------------------------------|---------|----|----------|
|                                 | 40 days | 60 days |          |
| Dry Matter                      |         |    |          |
| Digestibility1, %               | 67.29   | 56.93 | 0.18 **  |
| Rate of degradation, % hour-1   | 4.54    | 3.08  | 0.10 **  |
| Lag, hour                       | 1.58    | 3.15  | 0.11 **  |
| Extent2, %                      | 70.42   | 67.57 | 0.41 **  |
| Neutral Detergent Fiber         |         |    |          |
| Digestibility1                  | 60.81   | 52.50 | 0.36 **  |
| Rate of degradation, % hour-1   | 4.13    | 2.64  | 0.15 **  |
| Lag, hour                       | 1.91    | 3.61  | 0.13 **  |
| Extent2, %                      | 71.00   | 61.60 | 0.30 **  |

Means within row bearing different superscripts differ significantly (p<0.05); 1Degradability was determined at 48 hours of incubation; 2Extent of digestion was determined at 96 hours of incubation.

**IN SITU DM AND NDF DEGRADABILITY**

Increased cell wall components and decreased cell contents of forages with increasing maturity were the possible reason for lower NDFD with advancing age of maturity (Givens et al. 1989; Rinne et al., 1999; Rinne et al., 2002). Buxton and Hornstein (1986) and Miller et al. (1991) reported inverse function of lignification for both in vivo and in vitro digestion which might be owed to mature lignification and structural carbohydrates. It was opined previously that rumen microbes favorably use starch or cell soluble over fiber. The decline in rate of disappearance might be ascribed to augmented concentration of NDF and lignin in matured fodders. Cleale and Bull (1986) explored that potentially digestible DM of early cut grasses/legumes silage was digested faster than late cut silage. Results of present study have supported the findings of Bowman et al. (1991) who suggested that ADL contents of forage increased with the advancement in maturity of forages thus reduced the potential extent of NDF disappearance. Similarly, Cherney and Lucey (1993) conveyed that effect of forage maturity on the DM digestibility is a variation in fiber content across premature and mature cut maize, as well as in ruminal milieu.

**CONCLUSION**

The maize verities harvested at 40 days of maturity had higher CP contents and better in situ DM and NDF digestion kinetics in Nili-Ravi buffaloes.
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