Forage Res., **43** (2) : pp. 97-100 (2017) **http://forageresearch.in**

ASSESSMENT OF DIETARY FIBRE IN CAKE OF DIFFERENT SUNFLOWER GENOTYPES

BUNTY SHARMA*, R. K. SHEORAN, NARESH KUMAR THAKRAL, VIVEK K. SINGH AND REENA

Department of Genetics & Plant Breeding
CCS Haryana Agricultural University,
Hisar-125 004 (Haryana), India
**(e-mail : sharmabunty097@gmail.com)*

(Received : 15 April 2017; Accepted : 27 June 2017)

SUMMARY

Sixteen genotypes of sunflower (*Helianthus annuus* L.) were studied at Oilseeds Section, Department of Genetics Plant Breeding, CCSHAU, Hisar during spring 2015, for structural carbohydrates and *in vitro* digestibility. Neutral detergent fiber, acid detergent fiber and lignin varied from 26.8′ to 35.2′, 19.9′ to 27.7′ and 6.19′ to 9.28′, respectively. Cellulose varied from 17.5 to 26.4 per cent, whereas hemicellulose content ranged between 4.52 and 5.89 per cent. Variation in protein and crude fibre was from 24 to 30 and 30.11 to 40.40. In the whole seed meal (cake), all samples had a high NDF content than ADF contents. The genotype HSFH 1599 showed maximum hemicellulose content, while minimum lignin content. The genotype HSFH 1589 showed lower values for crude fibres and cellulose content. A highly significant but negatively correlated was observed between ADF and NDF. CF showed highly significant and positive correlation with ADF, cellulose and lignin. A genetic strategy of breeding material can bring about a highly nutritive genotype of sunflower for animal feed.

Key words : ADF, NDF, dietary fibre, correlation and sunflower cake

Protein and energy are two major component of feed that directly influence the production and growth of animals. Protein is quite expensive component, but an essential nutrient for growth and fattening of livestock. Now-a-day, different food crops are widely used as a major and cheap source of calories and proteins, particularly, in the developing countries (Cassidy *et al*., 2013). Sunflower wastes have potential for supplementation in ruminant diet (Ashwani and Vikas, 2014). In this regard, Mafakher *et al*. (2010) reported that sunflower waste silage had 12.87 per cent crude protein (CP). The nutritional value of sunflower silage for ruminant is equal to 80 per cent of corn and 80-90 per cent of corn silage (Rad and Lotfi, 2013). In growing cattle, sunflower hulls may be included up to 20 per cent dietary level to increase the total fibre content in the diets of dairy heifers or to provide roughage in high-grain rations for growing or finishing beef cattle (Malik and Saini, 2016). In dairy heifers, sunflower hulls included at 10 to 40 per cent decreased nutrients (DM, CP and ADF) digestibility. Studies of relationships of a lowered dietary fibre intake with several diseases such as diabetes, cancer of the colon, obesity, disorders in cholesterol metabolism and on its effects in mineral and micronutrient balance, protein digestibility, etc. have been the subject of many papers. As we know, the use of crude fibre (CF) is not convenient in food analysis because some non-digestible constituents are dissolved and some digestible components remain in the residue during determination. More significant is dietary fibre, where the neutral-detergent fibre (NDF) residue, obtained by treating the vegetable matter with neutral detergent, remains the principal component of the cell walls. It is suggested that healthy adults should eat between 20 and 35 g of dietary fibre each day. Lambo *et al.* (2005) reported cereals to be one of the main sources of dietary fibre, contributing to about 50 per cent of the fibre intake in western countries, 30-40 per cent dietary fibre may come from vegetables, about 16 per cent from fruits and the remaining 3 per cent from other minor sources. The FAO has recommended the substitution of CF values for dietary fibre values in tables of food composition. On the other hand, the knowledge of the hemicellulose and cellulose contents of vegetables may be important for industrial applications such as production of furfural, active carbons and other substances to increase the microbial growth in soils (Linares-Solana *et al.*, 1980) and for use in mixtures for animal feeding. Many investigators have studied the characteristics of sunflower meal (cake) in animal nutrition (Richardson *et al*., 1981;

Anandan *et al.*, 2002, Maheri-Sis *et al.*, 2011; Anonymous, 2013). Variability in structural carbohydrates and quality characters of forages (Tyagi and Bansal, 1980) and grasses (Gupta and Pradhan, 1975) have been worked out extensively. However, little information on structural carbohydrates is available in the sunflower meal (cake). The present investigation was carried out to evaluate the quality characters like crude fibre (CF), crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF), cellulose, hemicellulose and lignin in the meal (cake) of sunflower in 16 hybrids of sunflower.

MATERIALS AND METHODS

Seed samples of 16 genotypes of sunflower were collected from Oilseed Section, Department of Genetics & Plant Breeding, Chaudhary Charan Singh Haryana Agriculture University, Hisar. The seeds were hand cleaned and oven-dried. The cleaned and dried samples were freed from oil by Soxhlet apparatus using petroleum ether (60-80°C) as solvents. Thus, meal (cake) obtained was used for further analysis. The samples were analyzed for proximate composition (AOAC, 2005) and fibre fractions, i. e. CP, CF, ADF, NDF, hemicellulose, cellulose and lignin (Van Soest *et al*., 1991).

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant differences for all the six characters studied (Table 1). Ranges for the respective characters are presented in Fig. 1. The range of variation was maximum for crude fibre (32.37- 41.27%) followed by NDF (27.53-35.00%) and cellulose (18.87-26.27%), while it was lowest in the case of hemicellulose (4.46-5.85%) (Fig. 1).The contents of acid detergent fibre (ADF), neutral detergent fibre (NDF), hemicellulose (H), cellulose (C), lignin (L) and crude fibres (CF) for the 16 samples studied were estimated and results on these parameters are presented in Table 2. Average ADF, NDF, hemicellulose, cellulose, lignin and crude fibre of the tested genotypes were 28.32, 31.18, 5.26, 21.21, 7.77, 34.25 and 27.68 per cent respectively, and statistically these parameters did not vary or statistically similar, however, the contents varied significantly among the genotypes tested, and higher than the mean value of the group. Both acid detergent fiber (ADF) and neutral detergent fiber (NDF) are frequently used as standard forage testing tools for fiber analysis. NDF is used to predict intake potential of feed and with the increase in fibre the forage quality declines. The NDF is considered a close approximation of the total fiber constituents of feed stuffs, since it measures cellulose, hemicellulose, lignin, silica, tannins, and cutins, etc. NDF varied from 26.8 (HSFH 1549) to 35.2 per cent (HSFH 1619). As NDF concentration is negatively correlated with dry matter intake i. e. as NDF in the forage increases, animals will consume less forage so; consequently, NDF is often used in formulas to predict the dry matter intake in feed. Though lignin is indigestible, hemicellulose and cellulose can be digested by micro-organisms in animals with either a rumen (e.g. cattle, goats, or sheep) or hide-gut fermentation (e.g. horses, rabbits, guinea pigs) as part of their digestive tract but in varying degrees. The maximum hemicellulose content was observed in HSFH 1599 (5.89%), while

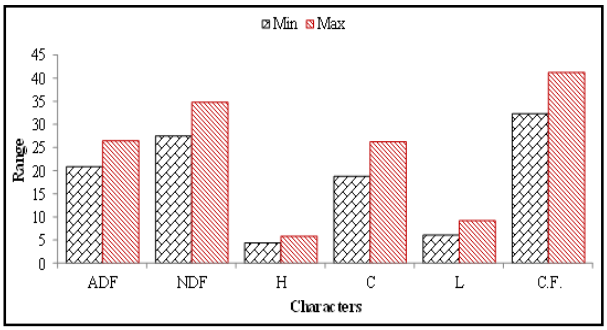

Fig. 1. Range for six nutritional quality traits in sunflower.

TABLE 1

Analysis of variance for nutritional quality traits in sunflower

Source of Variation	MS of characters						
	d. f.	ADF	NDF	H	C	L	CF
Treatments	15	11.185**	19.424**	0.490*	14.096**	2.448*	19.695**
Error	32	0.905	0.964	0.211	0.977	1.001	1.250
CV (%)		4.053	3.133	8.712	4.620	12.813	3.201
CD		1.590	1.641	0.767	1.651	1.671	1.868

d. f. : Degree of freedom and CV : Coefficient of variation. *,**Significant at P=0.05 and P=0.01 levels, respectively.

minimum (4.52%) was recorded for HSFH 1619. The cellulose content varied from 17.5% (HSFH 1632) to 26.4% (HSFH 1589). The maximum lignin content was observed for HSFH 1549 (9.28%) while minimum (6.19%) for HSFH 1599. A published study on sunflower (Anonymous, 2013) shows lower CP (5.72%), greater NDF (65.19%).ADF is often used to calculate digestibility and precise laboratory testing of feed and forage is required to provide the information needed to formulate animal supplies.Testing to assess quality also provides a basis for commercial feed sale. The fibrous component represents the least palatable fiber portion of forage . To calculate digestibility commonly ADF is estimated. In the whole seed meal (cake), ADF ranged from 19.90% (HSFH 1619) to 27.7% (HSFH 1573). As can be observed, all samples have a high NDF content than ADF contents. But all the genotypes have ADF content low than 27% that is recommended for superior quality of feed which show a potential use of sunflower in feed. Crude fibres ranged from 30.11% (HSFH 1632) to 40.4% (HSFH 1589). The lower value of Lignin, NDF and ADF indicates the high *in vitro* dry matter digestibility (IVDMD), because these components reported to be negatively correlated with IVDMD (Arora *et al.*, 1975). Anandan *et al.*, (2002) had investigated on sunflower heads based complete feeds by *in vitro* analysis. In their study, incorporation of sunflower heads as a sole roughage resulted in higher digestibility values. They had suggests that sunflower heads can be a satisfactorily substitute for conventional roughages in complete diets for ruminant. The lower value of Lignin, NDF and ADF indicates the high *in vitro* dry matter digestibility (IVDMD), because these components reported to be negatively correlated with IVDMD (Arora *et al.*, 1975). The genotype HSFH 159 identified for having lowest lignin content and low ADF and NDF while genotype HSFH 161 for lowest ADF, hemicelluloses and protein. Forages with higher ADF are lower in digestible energy than forages with lower ADF.

The simple correlation matrices analyses were conducted to evaluate the correlation between different chemical components, listed in table 3. As shown in table, ADF were highly but negatively correlated with NDF ($P<0.01$), and the greatest significant and positive correlation coefficient was observed between ADF and CF ($P<0.01$). Highly significant ($P<0.01$) and negative correlation was observed between NDF and hemicellulose. Cellulose showed significant and negative correlation with hemicellulose ($P<0.05$). CF showed highly significant ($P<0.01$) and positive correlation with ADF, cellulose and lignin.In general, CF was positively associated with all other characters except with hemicellulose.

TABLE 2
Tables of mean of six nutritional quality traits in sunflower

Genotype	ADF	NDF	H	C	L	CF
	Mean±S. E.	Mean ± S. E.	Mean± S. E.	Mean± S. E.	Mean± S. E.	Mean± S. E.
HSFH 1194	24.3±0.61	34.00±0.61	4.87±0.48	22.77±0.58	7.84±0.58	35.48±0.74
HSFH 1202	25.10±0.61	29.80±0.61	5.32±0.33	18.87±0.59	8.14±0.58	32.58±0.51
HSFH 1213	21.00±0.40	32.30±0.61	5.32±0.28	19.77±0.58	7.05±0.58	32.65±0.74
HSFH 1549	23.10±0.61	27.53±0.48	5.72±0.31	21.17±0.58	9.31±0.58	36.40±0.74
HSFH 1551	22.90±0.61	31.80±0.61	5.03±0.19	20.77±0.58	6.80±0.58	32.77±0.61
HSFH 1558	26.27±0.34	33.00±0.61	5.70±0.25	22.47±0.58	8.62±0.58	37.64±0.47
HSFH 1573	26.53±0.03	28.20±0.61	4.94±0.14	23.27±0.58	6.94±0.58	34.95±0.74
HSFH 1589	25.67±0.49	34.30±0.61	4.87±0.34	26.27±0.41	9.04±0.58	41.27±0.45
HSFH 1594	22.30±0.61	27.53±0.44	5.55±0.28	20.57±0.58	8.28±0.58	34.64±0.74
HSFH 1599	21.50±0.76	31.00±0.61	5.67±0.26	22.87±0.58	6.22±0.58	36.35±0.84
HSFH 1602	21.20±0.61	31.60±0.61	5.29±0.23	19.97±0.58	7.41±0.58	32.75±0.61
HSFH 1616	23.14±0.61	32.80±0.61	5.40±0.20	20.47±0.58	7.57±0.58	33.45±0.74
HSFH 1619	21.33±0.17	35.00±0.36	4.46±0.27	19.07±0.58	8.24±0.58	32.37±0.52
HSFH 1632	21.40±0.61	29.90±0.61	5.85±0.17	18.90±0.59	6.75±0.58	32.67±0.44
HSFH 848	24.60±0.61	34.40±0.61	4.77±0.13	24.87±0.58	7.81±0.58	38.43±0.49
PSH 996	25.30±0.61	28.33±0.38	5.54±0.17	20.27±0.58	8.85±0.58	34.61±0.74
C. D.	1.59	1.64	0.77	1.65	1.67	1.87
SE. (m)	0.55	0.57	0.27	0.57	0.58	0.65
SE. (d)	0.78	0.80	0.38	0.81	0.82	0.91
C.V. (%)	4.05	3.13	8.71	4.62	12.81	3.20

TABLE 3
Correlation coefficients among chemical analyses.

Characters	ADF	NDF	H	C	L	CF
ADF	1.000	-0.132	-0.192	0.522*	0.368	0.561*
NDF		1.000	-0.528*	0.317	-0.072	0.170
H			1.000	-0.217	0.020	-0.017
C				1.000	0.184	0.923**
L					1.000	0.510*
CF						1.000

*P < 0.05 and **P < 0.01.

CONCLUSION

All the genotypes had ADF less than 27 per cent and high protein content, which was good sign for its use as animal feed. The inclusion of sunflower meal (cake) in the diets resulted in an increase of the neutral detergent fibre and crude fibre. It can be concluded that fresh sunflower meals (cake) can be used in ruminant nutrition.

REFERENCES

Anandan, S., K. G. K. Anil, M. S. Rudraswamy, and K. S. Ramachandra. 2002 : *In vitro* evaluation of sunflower heads based complete feeds. *Indian J. Anim. Nutr.,* **19** : 374-377.

Anonymous. 2013 : Nutritional evaluation of sunflower straw and plate on sheep. Agric. Sci. Paper. p. 172.

AOAC. 2005 : *Official Methods of Analysis. 18th edn.* Association of Official Analytical Chemists, Virginia, USA.

Arora, S. K., R. S. Paroda, Y. P. Luthra, and B. Das. 1975 : Genetic variability in structural components and *in vitro* digestibility of fodder samples of promising grain varieties. *Nutr. Dietet.,* **12** : 53-59.

Ashwini, T., and L. Vikas. 2014 : Effect of moisture content on the physical properties of sunflower seeds (*Helianthus annuus* L.) for development of power operated sunflower seed decorticator. *Int. Sci. and Res.* **3** : 2298-2302.

Cassidy, E. S., P. C. West, J. S. Gerber, and J. A. Foley. 2013 : Redefining agricultural yields : from tonnes to people nourished per hectare. *Environ. Res. Letter's.* doi: 10.1088/1748-9326/8/3/03401.

Gupta, P. C. and K. Pradhan. 1975 : Prediction of *in vitro* dry matter digestibility of legumes and non-legume forages from various chemical constituents. *Indian J. Dairy Sci.,* **28** : 12-16.

Lambo, A. M., R. Oste, and M. E. G. Nyman. 2005 : Dietary fibre in fermented oat and barley β-glucan rich concentrates. *Food Chem.,* **89** : 283-293.

Linares-Solana, A., J. Lopez Gonzalez, M. Molina Sabio,F. Rodtiguez Reinoso. 1980 : *J. Chem. Tech Biotechnol.* **30** : 65.

Mafakher, A., M. Meskarbashi, P. Hasibi, R. Mashayekhi, and J. Baghaeipour. 2010 : Evaluation of chemical composition and physical traits of ensiled corn and sunflower in different ratios. In : Proc. 4th Iranian Congress of Animal Science. pp. 1601-1604.

Maheri-Sis, N., A.R. Baradaran-Hasanzadeh, R. Salamatdoust, O. Khosravifar, A. Agajanzadeh-Golshani, and J. Dolgari-Sharaf. 2011: Effect of microwave irradiation on nutritive value of sunflower meal for ruminants using *in vitro* gas production technique. *The J. Anim. & Plant Sci.,* **21** : 126-131.

Malik, M. A., and C. S. Saini. 2016 : Engineering properties of sunflower seed : Effect of dehulling and moisture content. *Cogent Food Agri.,* **2** : http://dx.doi.org/10.1080/23311932.2016.

Rad, M. N., and A. Lotfi. 2013 : Sunflower disc floret silage as feedstuff for ruminant; *in vitro* evaluation. *Bull. Env. Pharmacol. Life Sci.,* **2** : 45-49.

Richardson, C. R., R. N. Beville, R. K. Ratcliff, and R. C. Albin. 1981 : Sunflower meal as a protein supplement for growing ruminants. *J. Anim. Sci.,* **53** : 557-563.

Tyagi, I. D., and S. K. Bansal. 1980 : Comparison of different varieties of clusterbean for fodder production. *Guar Newsl.,* **1** : 11–12.

Van Soest, P. J., J. D. Robertson, and B. A. Lewis. 1991 : Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal's nutrition. *J. Dairy Sci.,* **74** : 358-359.