Nutritional Composition of Seventy five Elite Germplasm of Foxtail Millet (Setaria Italica)

M.Y. Kamatar, S. M Brunda, Sanjeevsingh Rajaput,
H.H. Sowmya, Giridhar Goudar
NAIP Component 2 Project
University of Agricultural Sciences
Dharwad 58005 , India

Ramaling Hundekar
Department of Plant Breeding and Genetics
Kerala Agricultural University
Tiruvanatpuram, India

Abstract **— Millets have been important food staples in human history, particularly in Asia and Africa. Grown under traditional methods can be termed as crops of organic farming food. Each of the millets is three to five times nutritionally superior to the widely promoted rice and wheat in terms of proteins, minerals and vitamins. To document the variability for nutrition composition for the benefit of food industry seventy five diverse germplasm line of foxtail millet were analysed for their nutrition. The genotypes exhibited highly significant differences for all the nutritional parameters viz., moisture, protein, fat, crude fibre, carbohydrate, total minerals, and total energy. Large amount of variation was observed among the genotypes for protein content ranging from 8.98 to 14.37 percent with a mean value of 12.63 per cent. The overall mean value of crude fiber content was 2.07 per cent and foxtail millet genotypes ranged from 1.34 and 2.31 per cent. The mean values for total minerals ranged between 1.08 and 1.57 per cent and overall mean of total minerals was 1.3 per cent. Considerable variation was also observed for fat per cent ranging from 2.79 to 4.16 with a mean value of 3.52. As much as 40 K.cal variation was observed between the genotypes with lowest energy (DHF 9; 326 K.cal) and genotype with highest energy (GS1000; 368 K. cal). Results indicated the ample scope is available for the farmers and food industry for exploitation of nutrients for the health and therapeutic benefits of consumers, thus rice and wheat products may be substituted by these elite foxtail millet genotypes**.

Keywords — Millet, Nutrition, Health, Fat, Fibre, Protein

INTRODUCTION

Millet provides a host of nutrients, has a sweet nutty flavor, and is considered to be one of the most digestible and non-allergenic grains available. Farmers of Karnataka grow millets organically with no pesticides and fertilizers, tolerant to diseases, can be cultivated with less water or under drought conditions, with less labour requirement [1]. It is one of the few grains that is alkalizing to the body. Each of the millets is three to five times nutritionally superior to the widely promoted rice and wheat in terms of proteins, minerals and vitamins. By any nutritional parameter millets are miles ahead of rice and wheat in terms of their mineral content compared to rice and wheat [2][3]. Healthy and therapeutic millet foods and ready to eat food products can be prepared from millets for maintenance of good health [3][4][5][6][7]. Among the eight millets, foxtail millet is fairly tolerant to drought. Due to its quick growth, it can be grown as a short-term catch crop. Its grain is used for human consumption and as feed for poultry and cage birds. Consumption of foxtail may prevent cardiovascular disease by reducing plasma triglycerides in hyperlipidemic rats [8]. A high intake of millet based dietary fiber, improves glycemic control, decreases hyperinsulinemia, and lowers plasma lipid concentrations in patients with type 2 diabetes in human beings.[3] [9]. Millets are also rich source of antioxidants. Now a days the role of antioxidants in human health is gaining more importance. Free radicals are produced in human body constantly and are capable of attacking the healthy cells of the body causing them to lose their structure and functions. Significant variability is available in foxtail millet for yield and yield contributing traits [10][11][12] and for nutrition parameters[13]. Keeping these points in view in the present investigation we aimed to find out the variability for nutrition parameters in germplasm of foxtail millet so that highly nutritive genotypes can be exploited by the food industry and used in the ready to eat food products for the benefit of public health.

MATERIAL AND METHODS

Total of 75 elite foxtail millet germplasm were collected from different sources. This material for experiment comprised of 44 germplasm collection of foxtail millet obtained from All India Coordinated Millet Improvement Project, Bangalore and 31 lines developed at Agricultural Research Station Hanumanatti. These genotypes were from different geographical origin viz., Andhra Pradesh, Tamil Nadu, Orissa, Bihar, Kerala,Uttar Pradesh, Karnataka, Rajastan, China, and USA hence had lot of diversity among themselves. These 75 accessions along with 3 national checks HMT 100 -1, PS 4 and Sia 326 were grown for multiplication during 2014 at University of Agricultural Sciences, Dharwad to have fresh and good quality grains for nutritive analysis.

Dehulling:

Harvested panicles seeds from this plot were collected, cleaned and dehulled using pestle and mortar. The dehulled grains were used for analyzing physical and nutritional characteristics.

Analysis of proximate composition

Proximate principles such as moisture, crude protein, crude fat and total mineral matter were analyzed according to standard AOAC procedures. Thirty foxtail millet samples were analysed for all these six parameters following the method mentioned below for calibrating the Near Infra Red Reflectance Spectroscopy to facilitate the nutrition analysis of 78 foxtail millet genotypes :

Moisture %

About 10 g of sample was weighed into previously weighed moisture cup and dried in an oven at 100-105°C till a constant weight was attained. Per cent moisture content was calculated as under:

$$\text{Moisture \%} = \frac{\text{Initial wt (g)} - \text{Final wt (g)}}{\text{Sample wt (g)}} \times 100$$

Crude protein

The nitrogen content of the grain was assessed by Kjeldahl method using Pelican Kelplus equipment. Crude protein was calculated by multiplying with a factor 6.25.

$$\text{Protein}_{(\%)} = \frac{\text{Titre value-Blank x N of HCl x 14.007 x 6.25}}{\text{Sample wt (g)}} \times 100$$

Crude fat

Moisture free sample was weighed in moisture free thimble and crude fat was extracted by refluxing in soxplus apparatus using petroleum ether as solvent. Per cent crude fat was calculated by difference .

$$\text{Fat}_{\%} = \frac{\text{Initial weight}_{(g)} - \text{Weight after extraction}_{(g)}}{\text{Sample wt (g)}} \times 100$$

Crude fibre

Crude fibre was estimated from the moisture and fat free sample. The residue obtained after digestion with acid and alkali was dried in crucible and weighed. The difference in weight of the crucible before and after ashing of the digested residues was taken as weight of the crude fibre (Anon 1990).

$$\text{Fibre}_{\%} = \frac{\text{Weight of residue) before ashing}_{(g)} - \text{Weight of residue after ashing}_{(g)}}{\text{Weight of fat free sample}_{(g)}} \times 100$$

After analysing the thirty foxtail millet grain samples for all these nutrition parameters by above procedures, the obtained values were used to pre calibrate the Near Infrared Reflectance Spectroscopy for the parameters moisture, protein, fat, carbohydrate, crude fiber, total minerals and total energy. The proximate parameters of seventy five genotypes were analyzed in Near Infrared Reflectance Spectroscopy. Further the genotypes selected for the study were analyzed by NIRS using the software ISI scan and WinISI for the above mentioned proximate parameters. NIR is a fast and non destructive technique that provides multi constituent analysis of virtually any matrix. The principle of detection and measurement of chemical composition of biological materials was based on vibration responses of chemical bonds to NIR radiations**.**

RESULTS AND DISCUSSION

The analysis of variance for nutritional quality parameters was carried out in 78 germplasm collections. The results are presented in Table 1. The genotypes exhibited highly significant differences for all the nutritional parameters viz., moisture, protein, fat, crude fibre, carbohydrate, total minerals, total energy. The mean performance of foxtail millet genotypes for nutritional traits is briefly presented in Table 2.

Moisture content (%)

The mean of moisture content was 9.48 per cent with a mean value ranging between 9.25 and 9.70 percent. Genotypes GS 2164, GS 2109 exhibited lowest moisture content of 9.25 per cent which are obtained from NBPGR New Delhi. K-2, Krishnadevaraya and H-1 had highest moisture content of 9.76 per cent. Moisture content determines the shelf life and milling characteristics of the grains. Lower the moisture content, higher shall be shelling percentage and length of shelf life of grains. Very low moisture content of 5.76 percent in 185 little millet land races was observed and no variation was observed moisture content between land races of different zones of Karnataka[14]. On the contrary land races differed for moisture content on the bases of glume colour variation in the little millet land races of Karnataka [15]. However, it is important to note that moisture alone does not determine the shelf life of millets, other components such as fats, phenols and alike also influence the keeping quality of grains.

Fat (%)

Considerable variation was observed for fat per cent among the genotypes ranging from 2.79 to 4.16 percent with a mean value of 3.52 percent. The fat content in all the categories of little millet was around 4.64 per cent [14]. Few studies have reported the fat content to be around 3.46 to 3.62 percent in proso millet, kodo millet, ltalian, Little and pearl millets [16][17][18]. Genotype Ise 900 had highest fat content of 4.16 per cent followed by DHF 12 and GS 592 (3.91%). Genotypes were ranged from 4.7 to 12.3 mg. DHF 24, DHF 26 and DHF 28 exhibited the lowest fat content of 2.79 per cent. Low fat content helps in increasing the shelf life of millets as higher oil content makes the dehulled millet grains rancid.

Protein content (%)

Millets are high in protein content than rice which is a staple food of south India. The protein content of millets. When compared to rice it is twice higher in the small millets. The recommended dietary allowance foe man and women are 60 and 50 grams of protein per day. It is fulfilled by consuming 600 grams of millets instead of 1000 grams of rice. Foxtail millet protein characterization showed that its protein concentrate is a potential functional food ingredient and the essential amino acid pattern suggests possible use as a supplementary protein source to most cereals because it is rich in lysine [19]. Large amount of variation was observed among the genotypes for protein content ranging from 8.98 to 14.37 with a mean value of 12.63 per cent. Among the 78 genotypes Ise 1468 had highest protein content of 14.37 per cent followed by GS 1000 (14.07%) and Ise 375 (14.04%).

DHF 26 exhibited lowest protein content of 8.98 per cent followed by DHF 24 (9.04%) and DHF 25 (9.97%). Extremely varying genotypes for protein content were belonging to different geographical origins like Karnataka, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Rajastan and Kerala. On the contrary variation was not observed for this trait in little millet land races of different zones of Karnataka[15]. Hence the present results indicate that vast geographical difference is needed to have diversity for nutrition composition in foxtail millet genotypes rather than different zone of the state. Forty five genotypes had higher protein content than the mean value of 12.63 percent. Among them only eleven genotypes Meera, Pratapkagni, Ise 375, Ise 1468, Ise 140, Ise 1647, GS 271, GS 1000, GS 2105, GS 592, DHF 1347, had higher protein than the local check HMT 100-1 (13.29%). Further only six genotypes viz., Ise 375, Ise 1468, Ise 140, GS 271, GS 1000, GS 2105 were significantly superior to high protein yielding check Sia 326. These genotypes may be multiplied for further utilisation by the farmers and food industry for the benefit of consumers. Substitution of these high protein genotypes to existing genotypes help the food industry to provide higher protein to consumers at lower cost.

Crude fiber (%)

Crude fiber plays an important role in the therapeutic benefits and maintenance of good health. Dietary fibers provide health benefits for many conditions including constipation, cardiovascular diseases, colon cancer, and diabetes [3]. However, dietary fibers are only one factor involved in these conditions. Dietary fibre which is present as soluble and insoluble form is proved to play an important role in the management of metabolic disorders like diabetes mellitus, hyperlipidemia[20], improve bowel motility and in turn reduce the incidence of colon cancer. Higher the fiber content in grains, slower the release of glucose in the blood, thus mange the diabetes. Similarly fiber plays role in lipid metabolism and control of obesity. Hence grains with higher content are desired. The overall mean crude fiber content was 2.07 per cent and genotypes ranged from 1.34 and 2.31 per cent. Out of the 78 genotypes of foxtail millet genotype DHF 27, had highest fiber content of (2.31%) followed by GS 2109 (2.28%) and DHF 2 (2.24%) whereas the K 2 genotype exhibited lowest fibre content of 1.34 per cent followed by Ise 900 (1.89%) and Krishnadevaraya (1.91%).

Carbohydrate (%)

Carbohydrates provide quick energy to the body. Usually millets contain ample quantity of carbohydrates in their grains but comparatively they have low proportion of carbohydrates than rice and wheat. Carbohydrate content in the 78 foxtail millet genotypes ranged 70.90 and 75.63 mg/100g with a average mean value of 72.89 mg/100g. The highest carbohydrate content was recorded in the genotype DHF 26 (75.63%) followed by DHF 11 (75.54%) and DHF 25 (74.45%). The genotype Ise 1468 (70.90%) has recorded lowest carbohydrate among all the genotypes followed by Ise 1312 (71.40%) and Ise 1468 (70.90%). Lower carbohydrates and high fiber content in food is desirable for maintenance of good health especially for diabetics and cardiovascular patients.

Total minerals (%)

Millets quantitatively provide much more total minerals than the common cereals like maize, sorghum, rice, and wheat with a range of 0.6 to 2.5 per cent. Minerals increase the resistance power of the human body against so many diseases. In the present study treatment variance for the total mineral content among the genotypes was significant even at 1 per cent level. This result indicates the presence of variability in foxtail millet germplam studied was due to their wide geographical origin. The mean values ranged between 1.08 and 1.57 per cent and overall mean of total minerals was 1.3 per cent. Genotype Krishnadevaraya from Andhra Pradesh has recorded the highest mineral content of 1.57% followed by Ise 1312 (1.47%) and DHF 13 (1.46%) whereas lowest was recorded in Karnataka genotype DHF 30 (1.08%) followed by DHF T 1 (1.09%) and GS 2164 (1.10%) of NBPGR. Variation for mineral content are reported in little millet [13].

Total energy (K.cal)

Humans and other animals need a minimum intake of food energy to sustain their metabolism and drive their muscles. Foods are composed chiefly of carbohydrates, fats, proteins water, vitamins, and minerals. Carbohydrates, fats, proteins, and water represent virtually all the weight of food, with vitamins and minerals making up only a small percentage of the weight. Carbohydrates, fats, and proteins comprise ninety percent of the dry weight of foods. Food energy is derived from carbohydrates, fats and proteins as well as organic acids, and ethanol present in the diet. As much as 40 K.cal variation was observed between the genotype with lowest energy (DHF 9; 326 K.cal) and genotype with highest energy (GS1000; 368.61k cal). Total energy is dependent of protein, fat and carbohydrates proportion in the food grain. At this juncture vast variability in total energy may be attributed to variation in those traits viz., fat, protein and carbohydrate. Genotype K 2 and GS 2159 were the second highest by recording total energy of 367.4 k cal. Overall mean of all the genotype was 363.48 k cal.

The present investigation on nutrient composition revealed that lot of variability is available in elite germplam of foxtail millet which provides ample scope is to the farmers and food industry for exploitation of nutrients for the heath and therapeutic benefits and in turn to maintain good heath and build the man power of the country. Physical, mental strength and health solely dependent on the nutrition provided to the body. Hence rice and wheat products may be substituted by the grains of elite foxtail millet genotypes of the present study. Further search may be done to have still higher nutrition profile in foxtail millet crop.

REFERANCES

[1] S. Hemalatha, M.Y. Kamatar and Rama K. Naik 2013. Socioeconomic profile of millet growers in Karnataka. Research Journal of Agricutural Sciences,4(3): 333-336.

[2] C. Gopalan, B.V. Ramasastri and S.C. Balaubramanian. Nutritive value of Indian foods. National Institute of Nutrition, ICMR, Hyderabad, 2007.

[3] M.Y. Kamatar 2013. Noble Millet Food Products for Quality Life of All Walks of Life and Age Groups (in) International Symposium on RTE Foods: Innovations in Ready-to-Eat Products: Drivers, Trends and Emerging Technologies held during 24-25 Sept 2013 at Mumbai, Maharastra, India. pp24-26.

[4] N.G. Kundgol, B. Kasturiba, K.K. Math, M.Y. Kamatar and M.Usha 2013. Impact of decortication on chemical composition, antioxidant content and antioxidant activity of little millet landraces. International Journal of Engineering Research and Technology 2(10): 1705-1720.

[5] M.Y. Kamatar, D.R. Meghana, Giridhar Goudar, S.M. Brunda and Rama Naik 2014. Healthy millet food products for quality public health. National Workshop on Emerging Technology in Processing and Value addition of millets for better utilization, March 13-14, 2014, Agriculture college and Research Institute, TNAU, Madurai-641003 pp 77-78.

[6] M.Y. Kamatar, Rama Naik and D.P. Biradar. Enrichment and Popularization of Potential Food Grains for Nutraceutical Benefits, Learnings from NAIP consortium value chain project. ICAR-UAS, Dharwad 2014.

[7] K. Kotagi, B. Chimmad, R.K. Naik and M.Y. Kamatar 2013. Nutrient enrichment of little millet (Panicum miliare) flakes with garden cress seeds. International Journal of Food and Nutritional Sciences 2(3): 36-39.

[8] S.H. Lee, I.M. Chung, Y.S. Cha and Y. Park 2010. Millet consumption decreased serum concentration of triglyceride and C-reactive protein but not oxidative status in hyperlipidemic rats. Nutr Res.30(4):290-6.

[9] M.V. Jali, M.Y. Kamatar , S.M. Jali, M.B. Hiremath and R.K. Naik 2012. Efficacy of value added foxtail millet therapeutic food in the management of diabetes and dyslipidamea in type 2 diabetic patients. Recent Research in Science and Technology, 4(7): 03-04.

[10] M.Y. Kamatar, S.M. Brunda, K.L. Naveenkumar, H.H. Sowmya, and R. Hundekar 2014. Genetic variability in foxtail millet germplasm across different soil moisture situations and seasons. National Symposium on Crop Improvement for Inclusive Sustainable Development, Nov. 7-9, 2014, Ludhiana. pp 884-885.

[11] S.M. Brunda, M.Y. Kamatar, K.L. Naveenkumar and R. Hundekar 2014. Study of Genetic Variability, Heritability and Genetic Advance in Foxtail Millet in both Rainy and Post Rainy Season. IOSR Journal of Agriculture and Veterinary Science.7(11) : 2319-2372.

[12] S.M. Brunda, M.Y. Kamatar, K.L. Naveenkumar, R. Hundekar, R. Gowthami 2014. Genetic Variability and diversity studies in Foxtail Millet for grain yield. National Seminar on Challenges and Innovative approaches in Crop Improvement. held during Dec 16-17,2014. Agriculture college and Research Institute, TNAU, Madurai-641003. pp 93.

[13] S.M. Brunda, M.Y. Kamatar H.H. Sowmya, Giridhar Goudar and Sanjaysigh Rajaput. Genetic variability and heritability for nutrition quality in a accessions foxtail millet. National Symposium on Crop Improvement for Inclusive Sustainable Development, Nov. 7-9, 2014, Ludhiana. pp 773-774.

[14] M.Y. Kamatar, S. Hemalatha, D.R. Meghana, S. Talawar and R.K. Naik 2013. Evaluation of Little Millet Landraces for Cooking and Nutritional Composition. Current Research in Biological and Pharmaceutical sciences 2 (1): 7-10.

[15] N.G. Kundgol, B. Kasturiba, K.K. Math, and M.Y. Kamatar 2014 . Screening of little millet landraces for chemical composition. International Journal of Farm Sciences Vol 4(2):33-38.

[16] R. Sahu 1987. Small millets on the dietary substitutes for major cereals in three tribal districts of Orissa. The Indian J. Nutr. and Dietetics, 24 : 1108-1113.

[17] L.R. Kulkarni, R.K. Naik, and P.A. Katarki 1992. Chemical composition of minor millets. Karnataka J. Agric. Sci., 5 (3) : 255-258.

[18] N.A. Hadimani, and N.G. Malleshi 1993. Studies on milling, physico-chemical properties, nutrient composition and dietary fibre content of millets. J. Food Sci. and Tech., 30 (1): 17-20.

[19] T.K. Mohamed, K. Zhu, A. Issoufou, T. Fatmata and H. Zhou 2009. Functionality, in vitro digestibility and physicochemical properties of two varieties of defatted foxtail millet protein concentrates. International J Molecular Sci 10:522–438.

[20] Mallikarjun Kamatar 2012. Foxtail millet therapeutic food in the management of diabetes and dyslipidamea (in) International Conference and Exhibition on Food Processing and Technology held during 22-24 November 2012 at Hyderabad, Andhra Pradesh, India. Journal of Food Processing and Technology 3(10) pp-118.

Table 1: Analysis of variance for nutritional components in foxtail millet Genotypes

Sources of variation	DF	Moisture	Protein	Fat	Crude Fiber	Total carbohydrate	Total minerals
Replications	2	0.19	0.06	0.01	0.01	13.10	0.01
Genotype	77	0.04**	3.43**	0.25**	0.05**	2.20**	0.53**
Error	154	0.01	0.01	0.01	0.01	0.75	0.22
CV		0.98	0.60	0.75	4.39	1.19	11.20
SE		0.06	0.04	0.02	0.05	0.50	0.08
CD @5%		0.15	0.12	0.04	0.15	1.40	1.39

Table 2 : Mean performance of 78 genotypes of foxtail millet with respect to nutritional parameters

Sl. No.	Genotypes	Moisture %	Protein %	Fat %	Crude fiber %	CHO %	Total minerals %	Total energy K cal
1	RFM-10	9.42	11.43	3.76	2.06	73.63	1.12	366.46
2	H-1	9.70	11.30	3.42	1.96	73.34	1.28	360.43
3	H-2	9.51	13.31	3.80	2.00	72.33	1.33	364.50
4	CO-4	9.53	12.81	3.34	2.04	73.61	1.28	365.05
5	K-2	9.76	10.83	3.14	1.34	73.78	1.35	367.41
6	Krishnadevaraya	9.75	12.05	3.28	1.91	73.21	1.57	361.77
7	Narasimharaya	9.40	12.83	3.51	2.11	73.82	1.13	366.19
8	Chithra	9.43	13.33	3.69	2.06	73.24	1.23	366.46
9	Arjuna	9.66	12.53	3.63	1.91	73.78	1.30	364.56
10	Srilakshmi	9.59	12.62	3.90	1.92	73.53	1.28	365.67
11	K-222-1	9.46	12.78	3.46	2.08	73.31	1.25	365.96
12	Sia -3085	9.66	12.06	3.31	1.94	72.19	1.39	362.34
13	Meera	9.45	13.88	3.57	2.06	71.57	1.31	364.65
14	Pratapkagni	9.42	13.55	3.70	2.06	72.77	1.29	366.62
15	Ise 375	9.43	14.04	3.59	2.08	71.54	1.37	364.87
16	Ise 1312	9.50	13.07	3.23	2.07	71.40	1.47	363.73
17	Ise 1468	9.36	14.37	3.65	2.10	70.90	1.33	365.45
18	Ise 1685	9.42	13.17	3.08	2.16	71.92	1.30	363.93
19	Ise 900	9.59	12.78	4.16	1.89	72.20	1.19	364.63
20	Ise 140	9.32	13.76	3.48	2.17	71.45	1.32	365.52
21	Ise 758	9.48	13.05	3.68	2.04	72.09	1.38	364.58
22	Ise 1647	9.59	13.53	3.57	2.00	72.67	1.38	363.64
23	Ise 931	9.57	13.07	3.82	2.06	72.36	1.43	362.35
24	GS 2164	9.25	12.96	3.57	2.21	72.19	1.10	366.10
25	GS 2040	9.30	13.36	3.51	2.17	73.12	1.17	367.07
26	GS 515	9.44	13.29	3.55	2.06	72.58	1.28	366.26
27	GS 949	9.47	13.05	3.40	2.07	73.38	1.36	365.41
28	GS 592	9.30	13.66	3.91	2.11	71.29	1.25	364.64
29	GS 511	9.49	13.30	3.67	2.14	72.36	1.28	362.75
30	GS 90	9.49	13.25	3.38	2.05	73.46	1.33	365.28
31	GS 121	9.55	12.94	3.58	1.98	73.07	1.36	365.38
32	GS 271	9.48	13.71	3.86	2.01	72.12	1.31	364.82
33	GS 740	9.60	13.13	3.86	1.92	71.96	1.28	364.89
34	GS 1000	9.37	14.07	3.60	2.11	71.50	1.33	368.61
35	GS 1483	9.57	11.46	3.41	2.03	72.75	1.41	362.83
36	GS 1560	9.59	12.91	3.52	1.98	72.44	1.37	363.45
37	GS 2099	9.27	13.96	3.71	2.19	71.43	1.35	363.63
38	GS 2105	9.48	13.70	3.59	2.05	71.86	1.27	364.43
39	GS 2109	9.25	12.94	3.11	2.28	72.28	1.18	365.27
40	GS 2126	9.54	11.27	3.07	2.07	73.82	1.34	364.54
41	GS 2159	9.33	13.62	3.76	2.12	72.90	1.34	367.40
42	GS 2192	9.36	12.89	3.50	2.18	72.49	1.34	362.57
43	GS 2197	9.50	12.72	3.49	2.05	72.74	1.36	364.01
44	GS 2215	9.47	13.30	3.76	2.03	73.39	1.27	366.37
45	DHF 21	9.53	11.97	3.35	2.06	72.88	1.23	363.56
46	DHF 22	9.62	10.49	3.08	2.15	73.80	1.28	360.38
47	DHF 23	9.43	13.47	3.81	2.07	71.48	1.23	362.68
48	DHF 24	9.55	9.04	2.79	2.17	74.43	1.41	359.79
49	DHF 25	9.51	9.97	2.92	2.19	74.45	1.28	360.25
50	DHF 26	9.65	8.98	2.98	2.08	74.63	1.26	359.35
51	DHF 27	9.35	10.90	2.79	2.31	73.91	1.30	361.15
52	DHF 28	9.46	11.06	2.79	2.20	73.53	1.25	363.08
53	DHF 29	9.39	10.86	2.83	2.23	73.45	1.20	363.44
54	DHF-30	9.39	13.96	3.32	2.18	72.95	1.08	364.53
55	ST-13	9.38	13.01	3.80	2.10	72.88	1.17	365.37
56	DHF 1	9.42	13.00	3.67	2.23	74.19	1.09	366.49
57	DHF 2	9.38	12.98	3.53	2.24	72.87	1.12	363.18
58	DHF 3	9.47	13.02	3.65	2.06	74.22	1.25	366.09
59	DHF 4	9.42	11.92	3.48	2.15	73.20	1.18	361.93
60	DHF 5	9.30	13.12	3.63	2.14	72.92	1.29	367.29
61	DHF 6	9.55	11.95	3.43	2.02	72.92	1.14	361.70
62	DHF 7	9.44	12.65	3.42	2.13	72.44	1.33	361.56
63	DHF 8	9.43	13.06	3.65	2.11	72.50	1.43	362.20
64	DHF 9	9.52	12.22	3.51	2.07	73.36	1.38	326.00

65	DHF 10	9.65	11.47	3.75	1.95	72.89	1.39	361.01
66	DHF 11	9.36	12.88	3.57	2.16	71.97	1.44	362.78
67	DHF 12	9.62	12.02	3.93	1.94	72.62	1.41	361.50
68	DHF 13	9.57	12.61	3.79	1.96	73.81	1.46	365.64
69	DHF 14	9.42	12.65	3.53	2.13	72.41	1.28	362.29
70	DHF 15	9.58	12.19	3.62	1.99	74.54	1.44	365.23
71	DHF 16	9.39	12.55	3.44	2.18	73.08	1.26	362.28
72	DHF 17	9.44	12.79	3.65	2.11	73.04	1.38	362.25
73	DHF 18	9.52	12.27	3.80	2.03	73.31	1.39	361.82
74	DHF 19	9.56	12.35	3.81	2.02	73.44	1.32	361.58
75	DHF 20	9.55	12.89	3.57	2.01	73.06	1.33	361.94
76	Hmt-100-1	9.60	13.29	3.83	1.95	72.73	1.33	363.95
77	PS-4	9.66	12.38	3.59	1.97	73.64	1.24	362.88
78	Sia-326	9.50	13.53	3.45	2.04	74.22	1.25	363.66
Mean		9.48	12.63	3.52	2.07	72.89	2.30	363.48
C.V.		0.98	0.60	0.75	4.39	1.19	11.20	0.47
S.E.		0.06	0.04	0.02	0.05	0.50	0.08	0.98
C.D @5%		0.15	0.12	0.04	0.15	1.40	1.39	2.74
C.D @1%		0.19	0.16	0.05	0.19	1.84	1.16	3.61