

Original Research Article

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## Evaluation of Foxtail Millet [*Setaria italica* (L.) Beauv.] Germplasm for Lysine Content

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### ABSTRACT

Foxtail millet (*Setaria italica* (L.) Beauv.) is a potential climate resilient, C4 Panicoid crop. It is commonly known as Italian millet and is a staple food crop grown in some parts of China, India and Japan. Nutrient composition of millets is higher than the average nutrient composition in major cereals (Muthamilarasan and Prasad, 2015). Research studies are lagging behind in nutrient profiling of millets. Hence, the present study was carried out with one hundred genotypes of foxtail millet procured from ICRISAT mini core collection (Upadhyaya *et al.*, 2011) for Lysine content. The range of values for these parameters ranged from 0.49-2.45 respectively, ISe 1610 (0.49g/100g of protein) recorded least amount of Lysine whereas ISe 1187 recorded highest amount of Lysine (2.45g/100g of protein). The study also reveals great variability existing among the collection of Italian millet accessions for Lysine that can be exploited to improve the cultivars to meet the nutritional requirements of humans.

#### Keywords

Foxtail millet,  
Lysine, Essential  
amino acid and  
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### Introduction

Nutrient superiority of millets in terms of its non-gluten protein, high fibre content, minerals, vitamins and antioxidants is firmly established over non-millet cereals, and hence these are popularized as 'nutricereals'. Foxtail millet (*Setaria italica* (L.) Beauv.) is a good source of micro and macronutrients with high

nutraceutical and antioxidant properties. It contains good amount of proteins, dietary fibers, vitamins, minerals, anti-oxidants and non-starchy polysaccharides with low glycemic index, when compared to major cereals (Taylor *et al.*, 2006; Amadou *et al.*, 2013; Muthamilarasan and Prasad, 2015). It is a valuable model to exploit phytonutrient pathways of millets. It has been suggested to

use foxtail millet protein as a food component to fight type 2 diabetes and cardiovascular diseases (Choi *et al.*, 2005). It was reported that Black and grey foxtail millet grains often have high amounts of protein along with high amounts of this indispensable amino acid Lysine (He *et al.*, 2002). Lysine is an essential amino acid (EAA) which cannot be synthesized by humans and should be supplied from food sources. Hence, profiling of available food sources for Lysine is of prime value. This study helps in identifying the genotypes with the essential amino acid lysine, which is said to be limiting in millets and cereals. This helps in improving the cultivars by exploiting required genotypes and making its cultivation remunerative to the farmers.

### Materials and Methods

The experiment was conducted during *kharif*, 2017 at Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh, which is located at 16.100 N latitude, 28.290 E longitude and 31.5 m altitude. One hundred germplasm accessions of foxtail millet procured from ICRISAT were laid out in Augmented RCBD and the seed samples of their germplasm were used for estimation of Lysine. Lysine was estimated as per the following procedure given by Theymoli and Sadasivam (1987). Firstly, enzymatic hydrolysis was done with papain solution resulting in liberation of free amino acids and low molecular weight peptides. The amino groups of the free amino acids were blocked with copper, while the  $\epsilon$ -amino group of lysine remains free. The  $\epsilon$ -dinitropyridyl derivative of lysine was formed upon reaction with 2-chloro-3, 5-dinitropyridine. Extraction of the reaction mixture with ethyl acetate removes the excess of 2-chloro-3, 5-dinitropyridine, leaving an aqueous solution of  $\epsilon$ -dinitropyridyl-lysine. The absorbance of this solution was measured at 390nm.

### Results and Discussion

Millets and other cereal grains are deficient in some of the indispensable amino acids such as Lysine (Geervani and Eggum, 1989). Vadivoo *et al.*, 1998 reported that proso millet grains are richer in essential amino acids and contain about 3.3g/kg of lysine when compared with that of other millets. The lysine content in foxtail millet germplasm ranges from 0.20% to 0.30% (Zhu *et al.*, 2004, Tian *et al.*, 2009). Some of the lysine rich foxtail millet cultivars (Gouweisu, 27531; Gouweisu, 27510; Xiomi, 27516) were reported by Zhu *et al.*, 2004. He *et al.*, 2002 reported that Black and grey seeded foxtail millet germplasm have higher lysine content. Kamara *et al.*, 2009 reported the range from 11.39-11.92g/100g of defatted foxtail millet flour and their amino acid profiling revealed to contain higher amount of lysine in foxtail millet protein. Chandel *et al.*, 2014 reported the mean value of lysine for Foxtail millet as 2.42 g/16g of N (RAU-8 genotype) which was higher when he compared it with that of Little millet and Finger millet.

In our present study one hundred germplasm accessions of foxtail millet were assessed for essential amino acid Lysine (g/100g of protein) content. The analysis of variance (ANOVA) revealed significant difference at 1% level for the trait studied (Table 1). The Range, mean values, SD, SE, CV%, obtained and the genotypes with Mean + SD for the quality parameter is presented in Table 2, The range of values obtained on analysis is 0.49g/100g of protein in ISe 1610 where as the highest amount of 2.45 g/100g of protein was recorded for ISe 1187 with the mean value of 1.48g/100g of protein. This shows that there are 22 genotypes which are above mean+SD values for Lysine which can be exploited for crop improvement and direct supplementation with other cereal based foods. The mean value of each genotype for the Lysine content is given in Table 3.

**Table.1** Analysis of variance (ANOVA) for Lysine in foxtail millet [*Setaria italic* (L.) Beauv.]

Sources of variations	d.f	Lysine (g/100g of protein)
		Mean sum of squares
Treatment	103	0.26 **
Treatment: Check	3	0.1 **
Treatment: Test vs. Check	1	1.42 **
Treatment: Test	99	0.26 **
Blocks	3	0.27 **
Error	9	0.01

\* Significant at 5% level

\*\* Significant at 1% level

**Table.2** Mean Performance, Range, SD, SE, CV% and the accessions with high Mean+SD for Lysine

S.No.	Parameters	Mean	Range	Std. Devia tion	Std. Error	CV%	Number & identified Genotypes	
							No. of genotypes	Best Genotypes High i.e>(Mean+SD)
1	Lysine(g/100 g protein)	1.48	0.49-2.45	0.50	0.05	33.80	22	ISe 1181, ISe 1227, ISe 1258, ISe 1286, ISe 1302, ISe 1338, ISe 1547, ISe 1575, ISe 1685, ISe 1704, ISe 1789, Ise 751, Ise 771, Ise 1118, Ise 1134, Ise 1137, Ise 1187, Ise 1201, Ise 1312, Ise 1320, Ise 1387, Ise 1563

**Table.3** Mean performance of 100 foxtail millet [*Setaria italica*(L.) Beauv.] Genotypes for Lysine content

S.No.	Genotype	Lysine (g/100g protein)	S.No.	Genotype	Lysine (g/100g protein)
1	Ise237	1.39	53	Ise 267	0.72
2	ISe 403	1.52	54	Ise 289	1.15
3	ISe 710	0.75	55	Ise 388	1.19
4	ISe 735	1.63	56	Ise 398	0.83
5	ISe 748	1.54	57	Ise 480	1.27
6	ISe 783	0.59	58	Ise 663	0.94
7	ISe 792	1.05	59	Ise 717	1.22
8	ISe 827	0.94	60	Ise 719	1.33
9	ISe 914	1.08	61	Ise 746	1.35
10	ISe 963	0.61	62	Ise 751	2.19
11	ISe 1067	1.65	63	Ise 758	1.52

12	ISe 1136	1.28	64	Ise 771	2.32
13	ISe 1161	1.82	65	Ise 828	0.94
14	ISe 1163	1.59	66	Ise 842	0.83
15	ISe 1177	1.5	67	Ise 846	0.62
16	ISe 1181	2.35	68	Ise 900	0.69
17	ISe 1227	2.07	69	Ise 969	0.83
18	ISe 1234	1.85	70	Ise 999	1.3
19	ISe 1258	1.99	71	Ise 1009	1.42
20	ISe 1286	2.3	72	Ise 1037	1.91
21	ISe 1302	2.04	73	Ise 1118	2.15
22	ISe 1305	1.72	74	Ise 1119	1.65
23	ISe 1332	1.64	75	Ise 1129	1.77
24	ISe 1338	2.07	76	Ise 1134	2.04
25	ISe 1460	0.83	77	Ise 1137	2.27
26	ISe 1474	0.87	78	Ise 1151	1.74
27	ISe 1547	2.12	79	Ise 1162	1.52
28	ISe 1575	2.24	80	Ise 1187	2.45
29	ISe 1597	0.61	81	Ise 1201	2.08
30	ISe 869	1.43	82	Ise 1209	1.19
31	ISe 1666	1.29	83	Ise 1251	1.12
32	ISe 1674	1.74	84	Ise 1254	1.85
33	ISe 1685	2.05	85	Ise 1299	1.37
34	ISe 1704	2.07	86	Ise 1312	2.04
35	ISe 1725	1.22	87	Ise 1320	2.09
36	ISe 1736	1.44	88	Ise 1335	1.83
37	ISe 1745	1.49	89	Ise 1387	2.19
38	ISe 1762	1.62	90	Ise 1400	0.62
39	ISe 1767	1.24	91	Ise 1454	0.85
40	ISe 1773	1.22	92	Ise 1458	0.87
41	ISe 1789	2.3	93	Ise 1511	0.8
42	ISe 1808	1.45	94	Ise 1563	2.12
43	ISe 1858	1.52	95	Ise 1581	0.63
44	ISe 1859	1.69	96	Ise 1610	0.49
45	Ise 1888	1.45	97	Ise 1638	1.74
46	Ise 2	1.22	98	Ise 1647	1.93
47	Ise 18	1.29	99	Ise 1655	1.71
48	Ise 49	1.37	100	Ise 1664	1.65
49	Ise 90	1.33	Checks	Korra local (C1)	1.42
50	Ise 96	1.62		Prasad (C2)	1.63
51	Ise 156	0.83		Suryanandi (C3)	1.78
52	Ise 238	1.1		C4(Ise 375)	1.9

In conclusion, healthy growth of human body and its functioning is the result of good nutrition (Branca *et al.*, 2015). Anitha *et al.*, 2019 reported that there is significant enhancement in the nutritional value of food when particular millets combined with legumes in 3:1 proportion, as it provides balanced amino acid with good protein digestibility. As cereals are limiting in protein and other micronutrients the study was done with millets and also the essential aminoacids (EAA) can be complemented with each other. Such studies require the profiling of essential aminoacids to choose the type and variety of millet. Thus the present study profiles this critical aminoacid, lysine content in 100 genotypes of foxtail millet. Among these total of 22 genotypes viz., ISe 1181, ISe 1227, ISe 1258, ISe 1286, ISe 1302, ISe 1338, ISe 1547, ISe 1575, ISe 1685, ISe 1704, ISe 1789, Ise 751, Ise 771, Ise 1118, Ise 1134, Ise 1137, Ise 1187, Ise 1201, Ise 1312, Ise 1320, Ise 1387, Ise 1563 were found to be Lysine rich genotypes. This study prompts for selecting enriched varieties for household consumption. More over industries can also explore the identified varieties to supplement this indispensable amino acid in preparation and development of products. Millets identified with this essential amino acid can also be exploited for the identification and mining of genes/alleles governing these traits.

## References

- Amadou I, Mahamadou E. Gounga and Guo Weile, 2013 Nutritional composition, some health benefits and processing – A Review Emirates journal of Food and Agriculture 25(7):501-508.
- Anitha. S, Govindaraj. M and Potaka J. K., 2019. Balanced amino acid and higher micronutrients in millets complements legumes for improved human dietary nutrition, Cereal Chemistry. 2019; 97:74–84.
- Branca, F., Piwoz, E., Schultink, W., and Sullivan, L. M. (2015). Nutrition and health in women, children, and adolescent girls. *British Medical Journal*, 351, 27–31.
- Chandel, G., R.K. Meena, M. Dubey, M. Kumar, Nutritional properties of minor millets: neglected cereals with potentials to combat malnutrition, *Curr. Sci.*107 (2014) 1109–1111.
- Choi Y, Osada K, Ito Y, Nagasawa T, Choi M, Nishizawa N. Effects of dietary protein of korean foxtail millet on plasma adinopectin, HDL-cholesterol and insulin levels in genetically type 2 diabetic mice. *Bioscience, Biotechnology and Biochemistry*. 2005; 69:31-37.
- He. J.H., T.Y.Yang and G.Z. Wu.2002. Evaluation on nutritive quality of local varieties for foxtail millet in Gansu province. *Journal of plant genetic resources*. 3:41-44
- Kamara TK, Zhu K, Amadou A, Tarawalie T, Zhou H. Functionality, *in vitro* digestibility and physicochemical properties of two varieties of defatted foxtail millet protein concentrates. *International Journal of Molecular Sciences*. 2009; 10: 5224-5238.
- Muthamilarasan and Prasad. *Advances in Setaria genomics for genetic improvement of Cereals and Bioenergy grasses Theoretical and applied genetics*, 2015:128(1): 1-14
- Sadasivam, S and Manickam, A. 1996. *Biochemical Methods*. New Age International Publishers, New Delhi.12-34.
- Sadasivam, S and Manickam, A. 1997.*Biochemical Methods*. New Age International Publishers, New Delhi. 22-23.
- Taylor J.N, Schober, T.J., Bean, S. R., 2006. Novel food and Non food uses for sorghum and millets. *Cereal Science*,

2006. 44:252-271
- Theymoli Balasubramanian and Sadasivam, S (1987) Plant Foods Hum Nutr 37 41.
- Tian, Z.F., H.P. Wang, Q. Y, Sun, X. Y, Deng, H. Y. Li and C. Yang, 2009. Study of the characteristics and quality of millet and the properties of aminoacid. FarmProd. Proc. 6: 21-22
- Upadhyaya, H.D., C.R. Ravishankar, Y. Narasimhudu, N.D.R.K. Sarma, S.K. Singh, S.K. Varshney, V.G. Reddy, S. Singh, H.K. Parzies, S.L. Dwivedi, H.L. Nadaf, K.L. Sahrawat, and C.L.L. Gowda. 2011. Identification of trait-specific germplasm and developing a mini core collection for efficient use of foxtail millet genetic resources in crop improvement.
- Vadivoo. A.S. R. Jodreph and N.M.Ganesan, 1998. Genetic variability and diversity for protein and calcium contents in finger millet (*Eleusine coracana*(L) Gaertn) in relation to grain color. Plant Foods Hum. Nutr. 52:353-364.
- Zhu, Z.H., W.X, Li FLiu, X.F. Zhang, S.C. Liu, Y. Li and W.Z. Wang 2004. Identification and evaluation of quality traits in millet germplasm. Rain fed Crops 24: 329-331.

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