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BIOCHEMICAL CHARACTERIZATION OF FENNEL (*FOENICULUM VULGARE*) GENOTYPES

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ABSTRACT

Fennel (*Foeniculum vulgare* Mill.), a flowering plant of the Apiaceae family, holds a prominent place in global agriculture and ethnomedicine. It is a traditional and popular herb with a long history of use as a medicine. The research was conducted at the Vegetable Research Centre, Department of Horticulture, Biotechnology Centre and Department of Food Science and Technology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India. Thirty Thee Genotypes were taken for biochemical study and we included biochemical and proximate analysis. i.e Protein, Fat, Oil, Crude fiber, Moisture and Ash%. Genotype FNL 137, FNL 138 and JF1 have higher protein% among all 33 fennel genotypes which was 4.33%, 4.23% and 4% respectively. In our present study, we found higher fiber % in these following genotypes among all 33 genotypes: FNL 133 - 51.00 %, JF 1 - 47.00% and have JF 12 - 47.32%. The ash% was found higher in these following genotypes FNL 136, JF 1 and FNL 133, among all the 33 genotypes which were 13.67%, 13.60% and 13.50%. These following genotypes recorded high amount of essential oil which were FNL 131, JF9 and JAGUDAN1 the amount was 4.79%, 4.75% and 4.50%. The highest moisture % genotypes were recorded in this study was JF1, RF187 and RF281 with the amount which was18.30%, 18% and 17.30%. The significant variations observed in protein, fiber, ash, essential oil, and moisture content suggest the potential for selecting and breeding genotypes with specific attributes for various applications in agriculture, nutrition, and industry.

Keywords **:** Fennel, Biochemical Characterization, Protein, Fat, Oil, Crude fiber.

Introduction

Fennel, a flowering plant belongs to the Apiaceae family. Its botanical name is *Foeniculum vulgare* Mill. Although it originated in the Mediterranean area, it is currently grown and used extensively throughout the world. The fragrant and tasty seeds, leaves, and bulbs of fennel are widely prized for their applications in food preparation, medicine, and cultural practices.

It is a traditional and popular herb with a long history of use as a medicine. A series of studies showed that fennel (*Foeniculum vulgare* Mill.) effectively controls numerous infectious disorders of bacterial, fungal, viral, mycobacterium, and protozoal origin. It has antioxidant, antitumor, chemo preventive, cytoprotective, hepatoprotective, hypoglycemic, and oestrogenic activities some of the scientist stated that *Foeniculum vulgare* has a special kind of memory-enhancing effect and can reduce stress (Badgujar *et al.,* 2014).

In India, Gujarat is the leading state in fennel production, which contributes about 80-85% of total production in India. (Anonymous, 2017) In India, present area under fennel cultivation is greatly increases from previous years with offering 90.0 thousand hectares with 157 thousand MT and productivity 1.575 MT/ha. Fennel, is a perennial herb. Its seeds are anise like in aroma and are used as flavourings soups, sauces, pastries, confectionaries, baked goods, meat and fish dishes, ice-cream, cordials, alcoholic beverages and in seasoning pickles.

The volatile oil is used in the manufacture of cordials and enters into the composition of fennel water, which in commonly given to infants as medicine. Essential oil composition depends upon internal and external factors affecting the plant such as genetic structures and ecological conditions; agricultural practices also have critical effects on yield and oil composition in the essential oil crops, although essential oil has some main components that can vitiate significantly according to the maturation period (Yadav *et al.,* 2013)

The edible fruit or seeds of the fennel plant are grown extensively. These are dry and sweet, and the fruit is wonderful when completely ripe. The fruit is frequently stored for later use, and fennel, a dried fruit, is a widely traded product. One of the plant foods with the highest concentrations of potassium, salt, phosphorus, and calcium is fennel. The Mission variety of fennel has the highest levels of dietary fiber and vitamins in relation to human needs, according to USDA data. Numerous more nutrients are present, albeit in lower amounts. Moisture: 6.24±0.24%. These analyses provide valuable information about the composition of fennel seeds, including their moisture content, protein, fat, fiber, ash, and NFE. Additionally, the mineral analysis revealed significant amounts of potassium, calcium, manganese, sodium, and iron in fennel seeds, while zinc is present in minimal quantities. Such data is important for evaluating the nutritional and chemical properties of fennel seeds and can be used in chemical screening or dietary assessment.

Materials and Methods

The research was conducted at the Vegetable Research Centre, Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India. The experimental site is in the Kymore Plateau and Satpura Hills region at an altitude of 411.78 meters above mean sea level. Geographically, Jabalpur is situated at 23.9°N latitude and 79.58°E longitude. Jabalpur experiences a semi-arid climate with a subtropical influence. The region is characterized by hot and dry summers, cold winters, and moderate to high relative humidity. The average annual rainfall is approximately 1350 mm, primarily concentrated between mid-June and October. Temperature variations are significant, with maximum temperatures ranging from 24°C to 45°C and minimum temperatures between 4°C and 22°C. Relative humidity ranges from 80-90% during the rainy season, 60-70% in winter, and 30-40% during summer. The experimental design employed was a Randomized Block Design (RBD) were utilized in the study, comprising germplasm collected from All India Coordinated Research Project (AICRIP project) Table 01.

Table 1 : Names of the Fennel Genotypes used for the study

S. No.	Name of Genotypes	Source of Collection	S. No.	Name of Genotypes	Source of Collection
1.	Local	Local area of Jabalpur	2.	RF 125	SKNAU, JOBNE
3.	FNL 130	AICRP ON SPICES	4.	RF 178	SKNAU, JOBNE
5.	FNL 131	AICRP ON SPICES	6.	RF 205	SKNAU, JOBNE
7.	FNL 132	AICRP ON SPICES	8.	RF 281	SKNAU, JOBNE
9.	FNL 133	AICRP ON SPICES	10.	JF 1	JAIPUR LOCAL
11.	FNL 134	AICRP ON SPICES	12.	JF 2	MANDSAUR LOCAL
13.	FNL 135	AICRP ON SPICES	14.	JF 3	MANDSAUR LOCAL
15.	FNL 136	AICRP ON SPICES	16.	JF 4	ETAH (U.P.)
17.	FNL 137	AICRP ON SPICES	18.	JF 5	KHARGON LOCAL
19.	FNL 138	AICRP ON SPICES	20.	JF 6	SHAJAPUR LOCAL
21.	FNL 139	AICRP ON SPICES	22.	JF 7	SHAJAPUR LOCAL
23.	FNL 140	AICRP ON SPICES	24.	JF 8	SHAJAPUR LOCAL
25.	FNL 141	AICRP ON SPICES	26.	JF 9	SHAJAPUR LOCAL
27.	FNL 142	AICRP ON SPICES	28.	JF 10	ALWAR LOCAL
29.	JAGUDAN 1	Spice Research Station Jagudan, Gujarat	30.	JF 11	CHITRAKOOT LOCAL
31.	JAGUDAN 2	Spice Research Station Jagudan, Gujarat	32.	JF 12	CHITRAKOOT LOCAL
33.	RF 101	SKNAU, JOBNER			

Protein Analysis: Protein estimation is done by Kjeldahl (1883) method Reagents-NaOH 40% 400g of NaOH was dissolved in 1 lit in distilled water.

Fat: The fat content of the sample was determined by the procedure as described in AOAC (1998).

Essential oil: The estimation of essential oil was estimated by the method prescribed by AOAC (1965),

Moisture: The moisture content in the sample was estimated according to the method of AOAC (1998).

Ash %: The ash content in the sample was determined by procedure as describe in AOAC (1998)

Crude Fiber: The crude fiber was determined by the method as described in AOAC (1998).

Result and Discussion

This study included biochemical and proximate analysis of following:

Table 02: Mean performance of thirty three genotypes of fennel for qualitative traits.

S. No.	Genotype's	protein %	fiber %	ash %	Essential oil %	moisture %
1	**LOCAL**	3.86	40.00	12.50	2.90	7.78
2	**FNL 130**	2.66	39.00	10.00	1.40	7.50
3	**FNL131**	1.60	45.00	11.32	4.79	8.90
4	**FNL 132**	2.38	49.00	13.30	3.60	14.83
5	**FNL 133**	2.86	51.00	13.50	2.66	10.91
6	**FNL 134**	2.91	38.40	12.80	3.10	15.10
7	**FNL 135**	2.73	35.13	12.22	2.50	8.98
8	**FNL 136**	2.68	48.33	13.67	1.79	7.80
9	**FNL 137**	4.33	39.00	11.89	2.50	9.10
10	**FNL 138**	4.23	28.99	9.87	1.99	7.79
11	**FNL 139**	2.22	41.77	12.98	2.55	9.20
12	**FNL 140**	2.26	45.65	13.21	3.20	14.30
13	**FNL 141**	3.83	49.32	13.56	2.99	10.11
14	**FNL 142**	3.79	37.00	11.67	3.98	12.44
15	**JAGUDAN 1**	2.80	29.68	9.96	4.50	17.10
16	**JAGUDAN 2**	2.99	36.22	12.87	4.32	15.40
17	**RF 101**	3.18	44.49	13.00	3.27	11.50
18	**RF 125**	3.25	38.32	12.10	4.20	14.60
19	**RF 178**	2.89	36.77	11.32	3.60	18.00
20	**RF 205**	3.20	38.00	11.65	3.66	13.22
21	**RF 281**	2.98	33.73	11.89	2.89	17.30
22	**JF 1**	4.00	47.00	13.60	3.12	18.30
23	**JF 2**	3.12	33.00	11.00	4.11	10.20
24	**JF 3**	3.23	28.43	9.50	1.98	13.20
25	**JF 4**	2.89	25.48	9.30	3.14	16.43
26	**JF 5**	3.67	45.32	13.00	3.32	14.20
27	**JF 6**	3.32	39.56	11.43	2.87	14.50
28	**JF 7**	4.20	28.99	9.88	3.22	8.33
29	**JF 8**	3.22	29.55	10.54	4.10	9.45
30	**JF 9**	4.20	35.46	12.12	4.75	12.80
31	**JF 10**	2.32	48.32	13.22	3.86	14.27
32	**JF 11**	3.12	39.55	12.50	3.22	16.11
33	**JF 12**	4.20	47.32	13.43	4.32	16.30
mean	**3.19**	**39.18**	**11.96**	**3.28**	**12.60**	**mean**
Max.	4.33	51.00	13.67	4.79	18.30	**Max.**
Min.	1.60	25.48	9.30	1.40	7.50	**Min.**

Protein (%) : The analysis of these fennel genotypes revealed a wide range of protein percentages, with values ranging from 1.60% to 4.33%. This substantial variability in protein content among different genotypes highlights the potential for selecting specific genotypes with desired protein levels for various agricultural and culinary purposes. So, FNL 137 has the highest protein content at 4.33%, while FNL 131 has the lowest protein content at 1.60% among the fennel genotypes in the dataset (Table no. 02).

Fiber (%): Genotype "FNL 133" exhibited the highest biochemical fiber percentage at 51%, making it the genotype with the maximum fiber content in this study. In contrast, JF 4 displayed the lowest biochemical fiber percentage at 25.48%, marking it as the genotype with the minimum fiber content among the examined genotypes (Table no. 02). The observed variations in biochemical fiber content suggest that fennel genotypes can significantly differ in their fiber composition. These findings may have implications for various applications of fennel, including dietary, medicinal, and industrial uses.

Ash (%): Genotype JF 1 exhibited the highest ash content at 13.6%, making it the genotype with the maximum ash content in this study. Conversely, JF 4 displayed the lowest ash content at 9.3%, marking it as the genotype with the minimum ash content among the examined genotypes. (Table no. 02). The significant variation in ash content observed among these genotypes suggests differences in their mineral composition. This information can have implications for dietary, medicinal, and industrial applications of fennel, depending on the desired mineral content

Essential oil (%): Genotype JAGUDAN 1 displayed the highest essential oil content at 4.5%, making it the genotype with the maximum essential oil content in this study. In contrast, FNL 130 exhibited the lowest essential oil content at 1.4%, marking it as the genotype with the minimum essential oil content among the examined genotypes. The significant variation in essential oil content observed among these genotypes highlights the diversity in the aromatic properties of fennel. This information can guide the selection of genotypes for essential oil production and the development of fennel cultivars with specific aromatic profiles for medicinal and culinary purposes.

Moisture (%): The moisture content of fennel genotypes ranged from as low as 7.5% (FNL 130) to as high as 18.3% (JF 1). These results demonstrate a considerable variability in moisture content among different fennel genotypes. Genotypes like JF 1, JAGUDAN 1, and RF 178 exhibited relatively higher moisture content, which might be of interest for applications requiring greater moisture retention, such as fresh consumption or certain culinary uses. On the other hand, genotypes such as FNL 130 and FNL 136 had lower moisture content, which could be advantageous for applications where moisture reduction is desirable, such as in spice production or drying for storage.

Fennel (*Foeniculum vulgare* Mill.) holds substantial economic significance due to its dual utility – both its seeds and leaves are valuable for domestic consumption and contribute to foreign exchange earnings. Despite its economic importance, fennel production has faced consistent challenges marked by persistently low yields.

Biochemical analysis is a broad field of study that involves the examination and characterization of the chemical compounds and processes occurring within living organisms. This analysis provides valuable insights into the composition, structure, and function of biological molecules and their roles in various biological process. "According to Yaldiz *et al*. (2019), the findings of this study revealed significant variability in essential oil content, ranging from 0.99% to 8.65%. This qualitative characteristic was also observed in studies conducted by Saxena *et al.* (2016), Bukhari *et al.* (2014), (Darbandi *et al*., 2023) and Saber *et al*. (2019). In biochemical study we included biochemical and proximate analysis. Genotype FNL 137, FNL 138 and JF1 have higher protein% among all 33 fennel genotypes which was 4.33%, 4.23% and 4% respectively. In our present study we find higher fiber % in these following genotypes among the all 33 genotypes FNL 133 - 51.00 %, JF 1 - 47.00% and have JF 12 - 47.32%. The ash% was found higher in this following genotypes FNL 136, JF 1 and FNL 133, among all the 33 genotypes which was 13.67%, 13.60% and 13.50%. These following genotypes recorded high amount of essential oil which were FNL 131, JF9 and JAGUDAN1 the amount was 4.79%, 4.75% and 4.50%. The highest moisture % genotypes were recorded in this study was JF1, RF187 and RF281 with the amount which was 18.30%, 18% and 17.30%. These studies were in agreement with the findings related to moisture, protein, fat, fiber, and ash content reported by Bukhari *et al.* (2014).

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