Quality evaluation of Ginger (*Zingiber officinale* Rosc.) germplasms under New Alluvial Zone of West Bengal, India

ABSTRACT

The study was conducted at the Department of Plantation, Spices, Medicinal and Aromatic Crops, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India during March-May, of 2020 and 2021. The objective of the present study was to evaluate the quality content of 18 ginger germplasm and to identify the most suitable promising genotypes under New alluvial zone of West Bengal. The result of the study shows that maximum essential oil content was obtained from the genotype Surabhi (1.65%) followed by Gorubathan (1.60%), Hui local (1.57%) and the lowest in Takeng local (0.88%). Highest oleoresin content was observed in the genotype Surabhi (7.88%) followed by Hui local (6.42%), Thinglaidum (6.34%) and the lowest was observed in Meghalaya local (3.51%). Maximum dry recovery was recorded in the genotype Gorubathan (23.00%) followed by Surabhi (22.20%), Hui local (22.02%) and the minimum in Moran ada (16.62%). Maximum crude fibre content was recorded in the genotype Takeng local (7.58%) followed by Jorhat local (7.40%) and lowest was with Surabhi (4.49%). Further, the maximum moisture and ash content were observed in Thinglaidum (14.21%) and Moran ada (7.25%) respectively. Thus, the genotypes viz., Surabhi, Gorubathan, Hui local, Thingria, Thinglaidum and Nadia gave an overall appreciable amount of quality content and were considered to be most suitable promising genotypes for their quality content in New Alluvial Zone of West Bengal.

Keywords: Quality evaluation; ginger; Zingiber officinale; germplasms; New Alluvial Zone of West Bengal.

1. INTRODUCTION

Ginger (*Zingiber officinale* Rosc.) is one of the well-known high-valued spice crops for its aroma, flavour and pungency due to the presence of essential oil and oleoresin content [1]. It belongs to the family Zingiberaceae and is native to humid tropical and subtropical forests of Southeast Asia [2]. Ginger is now commercially cultivated in tropical and subtropical countries in the world like India, China, Indonesia, Bangladesh etc. [3]. Ginger rhizome is commonly used in cuisines and medicines across the World either in a fresh, preserved, dry, powdered, or oil [4]. Ginger oil extracted from fresh ginger has a better fragrant flavour compared to oil extract from dry ginger and used in delicate

flavours in food processing, pharmaceuticals and perfumery formulations [5]. Good quality of oleoresin can obtain from dried powdered ginger by solvent extraction using acetone [6]. The demand of ginger oil and oleoresins have been increasing both in national and international markets due to their extensively used in food and pharmaceutical industry since they are more stable, contaminant free, cleaner and easy to blend [7]. Despite the COVID-19 Pandemic, India has exported 15,31,154 t of spices with a total worth ₹30,576 crores during the period 2021-2022. Among the total exported, spices oils and oleoresin products contributed to the export with 21,921 t worth ₹4,478.38 crores [8].

Some important ginger value-added products available commercially are curry powder, pastes, sauces, bread, ginger tea [9], beverages [10], pickles [11], confectionery [12], candies, pastries and cakes [13]. Ginger has also been used in Unani, Ayurvedic and Chinese medicines for the treatment of various ailments such as indigestion and constipation, colds, arthritis, nausea, diarrhea, helminthiasis, cancer, hypertension etc, [14,15,16]. Ginger varieties with low fibre content and higher dry recovery are important criterion for assessing the suitability of specific products for making dry ginger [4]. Ginger rhizomes are a rich source of phytochemicals which includes terpenes, phenolic compounds, carbohydrates, lipids, organic acids and raw fibres. Terpene components of ginger includes zingiberene, β-bisabolene, α-farnesene, β-sesquiphellandrene and α-curcumene which are known to be the main components of ginger essential oils [17]. The phenolic compounds gingerols (23-25%) and shogaol (18-25%) are responsible for the characteristic pungency of the ginger rhizome [18]. In addition to these compounds, ginger also possesses the following content viz., moisture (80.90%) water (9-12%), crude fibre (3-8%), protein (9%), ash (8%), phytosterols, minerals (1.2%) and vitamins [19,20]. The presents of these chemical compounds are determined by various factors like species, variety, maturity and processing conditions [21].

For commercial production, ginger with higher quality content is an important factor for increasing export income. however, the oil characteristics and quality contents vary with different cultivars, climatic conditions and agro techniques. There is a need for quality evaluation to identify the promising suitable genotypes with higher quality content under specific agro-climatic conditions. By keeping the above importance in view, the present investigation was studied to find out the most suitable genotypes performing better quality contents under New alluvial Zone of West Bengal.

2. MATERIALS AND METHODS

An experiment was conducted to evaluate the quality content among 18 ginger genotypes at the Department of Plantation, Spices, Medicinal and Aromatic Crops, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India during March-May, of 2020 and 2021. The field experimental site is located at 23º5' North latitude and 89º East longitudes with an altitude of 9.75 m above which falls under the sub-tropical climatic zone of West Bengal. The genotypes under the study were namely Thingpuri, Banada local, Hui local, Tura local, Khasi local, Meghalaya local,

Thingria, Thingpuidum local, Thinglaidum, Dibang takeng, Takeng local, Jorhat local, Moran ada, Tripura local and Nagaland local were local genotypes collected from one of most ginger diverse region of North Eastern states of India including varieties Nadia, Surabhi and Gorubathan were evaluated under the New alluvial zones of West Bengal with the application of recommended cultural practices and dose of fertilizers. Rhizomes were treated before planting in the field during end of April. Plant protection measures were also undertaken in the field, as and when necessary. The crop is harvested after 8-9 months of planting (February month) depend on variety or when the leaves turn yellow and start drying. Important quality parameters such as essential oil, oleoresin, dry recovery, crude fibre, moisture and ash content were estimated. Freshly harvested rhizomes are clean, sliced and dried in a hot air oven at 50ºC temperature [22,23]. The estimation of different quality parameters from the sample of eighteen ginger genotypes were analysed chemically according to the method of the Association of Official Analytical Chemists (AOAC) [24].

2.1. Essential oil (%)

Essential oil content on a fresh weight basis was obtained by steam distillation from freshly harvested rhizomes using Clevenger-type apparatus adopting standard procedure [25]. It was calculated according to the following formula.

$$\text{Essential oil (\%)} = \frac{\text{Oil yield (ml)}}{\text{Weight of sample taken (g)}} \times 100 \ldots\ldots\ldots\ldots \text{(1)}$$

2.1.1. Oleoresin (%)

Oleoresin content was estimated by Soxhlet apparatus per AOAC [26]. 5 g of powdered sample was refluxed with 125 ml of acetone then fitted Soxhlet flask along with condenser set and placed on the heating mantle at 40-60°C for about 3-4 h. Acetone extracted was transferred to pre-weighed beaker and the solvent was evaporated and weighed of the beaker including extract was recorded. The recovery of oleoresin was calculated and expressed in percentage by using the following formula.

$$\text{Oleoresin (\%)} = \frac{\text{Weight of oleoresin (g)}}{\text{Weight of sample taken (g)}} \times 100 \ldots\ldots\ldots\ldots\ldots \text{(2)}$$

2.1.1.1. Dry recovery (%)

100 g of freshly cleaned rhizomes were cut and dried in an oven at 50°C until a constant weight was obtained. The dry recovery percentage was worked out from the fresh rhizome weight of the sampled from the change in their weight after drying in an oven. It was calculated based on the following formula.

$$\text{Dry recovery (\%)} = \frac{\text{Dry weight of the rhizome after curing (g)}}{\text{Fresh weight of the rhizome (g)}} \times 100 \ldots\ldots\ldots\ldots \text{(3)}$$

2.1.1.1.1. Crude fibre (%)

5 g of sample weight (W1) of powdered rhizome was taken into the fibre flask and added 100 ml of 0.255 N H_2SO_4. Heat the flask at the heating mantle and filtered through a fibre sieve cloth. The

filtrate was discarded and residue was returned to the flask then added 100 ml of 0.313 M NaOH and heated again under reflux for 1 h. The mixture was filtered through a fibre sieve cloth and added 10 ml of acetone to dissolve any organic constituent. The residue was washed with 50 ml hot water twice on the sieve and transferred into the crucible. This crucible was oven dried at 105°C overnight to removed moisture. The oven-dried crucible containing ash was cooled in a desiccator and weighed to obtain W2. The difference W1-W2 gave the weight of fibre and were calculated using the following formula according to AOAC [27].

$$\text{Fibre (\%)} = \frac{W1-W2}{\text{Weight of sample(g)}} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots \text{(4)}$$

2.1.1.1.1.1. Moisture content (%)

5 g of fresh sample were weighed and kept in a previously weighed crucible (W1) and kept overnight inside an oven at 100°C. Oven-dried samples were removed and transferred to the desiccator and cooled for 10 m and weighed (W3) thus, the moisture content was calculated by using the following formula [27].

$$\text{Moisture (\%)} = \frac{W3-Wo}{W1-Wo} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots \text{(5)}$$

Where, Wo=Weight of empty crucible, W1=Weight of crucible+sample, W3=Weight of crucible+oven-dried sample.

2.1.1.1.1.1.1. Ash content (%)

5 g of a fine powdered sample was taken into porcelain crucible and kept inside the muffled furnace at a temperature of 550°C for about four hours until the sample turned to white ash. Cool down the sample to 100°C in air then to room temperature in a desiccator and record the weighed. It was calculated by using the following formula [27].

$$\text{Ash content (\%)} = \frac{\text{Weight of ash}}{\text{Original weight of sample}} \times 100 \ldots\ldots\ldots\ldots\ldots \text{(6)}$$

2.1.1.1.1.1.1.1. Statistical Analysis

The collected data from the experiment has been subjected to analysis of variance (ANOVA) for all quality parameters was performed by Gomez and Gomez [28] and the test of significance was carried out by referring to the standard “F” table suggested by Snedecor [29] at probability level of 0.05. The standard error of mean [S.Em (±)] and the value of critical difference (C.D.) to compare the difference means are provided in the tables of the results.

3. RESULTS AND DISCUSSION

The present experimental result on quality parameters from two-year pooled data of 18 ginger genotypes with different quality characters has been recorded and present in Table 1. It was observed that the essential oil content varied from 0.88%-1.65%. The highest essential oil content was obtained in Surabhi (1.65%) and closely followed by Gorubathan (control) (1.60%), Hui local (1.57%) Nadia (1.54%) and Thinglaidum (1.50%) while the lowest essential oil content was observed in Takeng local with 0.88%. The variation in essential oil content is conforming with Karthik et al. [30], who reported the

range of essential oil content varied from 0.92% (Acc-239)-1.71% (Acc-701) under similar climatic conditions. However, this variation of essential oil content might be due to genetic factors of different genotypes from different places of collection. These findings were also supported by earlier studies [31,32,33].

Significant variation in oleoresin content among the genotypes were observed with the highest content recorded in Surabhi (7.88%) followed by Hui local (6.42%), Thinglaidum (6.34%) while the lowest was recorded in Meghalaya local (3.51%). Similar results were also reported by Chongtham et al. [34] and Datta et al. [35], where the genotype Surabhi recorded the maximum oleoresin content with 10.25% and 10.30% respectively under West Bengal conditions, while the genotypes Thinglaidum, Khasi local and Nadia shows 5.44%, 5.08% and 4.29% respectively under Nagaland conditions [36]. The Oleoresin content of Nadia variety with 6.40 % was also reported by Surendra et al. [37], Under rainfed conditions in Manipur the ginger cultivar Gorubathan and Nadia were reported to show 4.88% and 4.61% oleoresin content respectively [38]**.** Chakraborty et al. [33] also recorded the lower oleoresin content in Gorubathan genotype.

Among the evaluated genotypes the maximum dry recovery was recorded in Gorubathan (control) (23.00%) followed by Surabhi (22.20%) and Hui local (22.02 %) and the minimum was found in Moran ada (16.62%). Chongtham et al. [34] obtained the maximum dry recovery in Sambuk (33.48%) followed by IISR Mahima (32.23%), Gorubathan (31.85%) and the lowest was obtained with IISR Rejatha (27.97%) under same West Bengal condition but Sasikumar et al. [39] reported that IISR Mahima and IISR Rejatha recorded dry recovery of 21.12 and 20.81%, respectively under Kerela condition. Datta et al. [35] also obtained dry recovery of (20.60%), (23.45%) and (20.30%) with Suprabha, Suravi and Gorubathan respectively. It was also reported that maximum dry recovery was recorded in GCP-49 (21.70 %) while the lowest was found in Gorubatha (17.22 %) under West Bengal conditions [33]. Such variation in dry recovery may be due to the present of their different composition and textural properties among these genotypes. The results of this variation in dry recovery have also been reported by previous studies [32, 40].

The analysis result of crude fibre content from evaluated genotypes showed that the highest crude fibre content was recorded in genotype Takeng local (7.59%) closely followed by Jorhat local (7.40%) and Hui local (7.26%) while the lowest was found in genotype Surabhi (4.49%) followed by Nadia (4.76%), Khasi local (4.91%) and Tura local (5.22%). Singh et al. [36] reported that maximum fibre content was found in the cultivar Nadia with 9.37% where the genotypes Tura (5.46%), Thinglaidum (4.53%) and Khasi local (4.52%) were reported significantly less under Nagaland condition. Another study showed that crude fibre content was recorded highest in Thinglaidum (7.03%), Thingpuri (5.93%), Tura (5.25%) and lowest in Nadia (4.35%) under Assam condition [41]. Maximum crude fibre content was observed in Manipur local (7.68%) followed by Gorubathan (6.17%), Bhaisey (5.71%) and lowest in Nadia (5.17%) under Manipur condition [38]. Chakraborty et al. [33] also observed a maximum crude fibre content in GCP-49 (5.30 %) while the lower crude fibre content in Gorubathan (4.46 %).

The maximum moisture content among the genotypes was recorded in Thinglaidum (14.23%) followed by Thingria (13.32%), Hui local (13.06%) and Thingpuri (12.83%) while, the minimum moisture content

Table 1: Performance of ginger germplasm for its quality parameters under New alluvial Zone of West Bengal (Pooled data of two years)

Germplasm	Essential oil (%)	Oleoresin (%)	Dry recover (%)	Crude fibre (%)	Moisture (%)	Ash (%)
Thingpuri	1.33	5.42	19.69	6.85	12.83	4.64
Banada local	1.20	5.83	20.20	6.94	12.37	5.58
Hui local	1.57	6.42	22.02	7.26	13.06	6.85
Tura local	1.25	4.89	18.65	5.22	12.67	4.00
Khasi local	1.46	4.11	19.93	4.91	11.76	5.50
Meghalaya local	1.15	3.51	19.14	5.69	11.53	5.31
Thingria	1.49	6.01	21.51	6.12	13.32	4.99
Thingpuidum local	1.38	4.93	20.32	6.31	11.83	4.74
Thinglaidum	1.50	6.34	21.80	7.10	14.23	4.41
Dibang takeng	1.49	6.24	17.37	6.56	11.26	5.22
Takeng local	0.88	4.46	19.30	7.59	11.44	7.07
Jorhat local	1.28	5.02	20.46	7.40	12.06	6.20
Moran ada	0.98	3.73	16.62	5.92	9.89	7.25
Tripura local	1.09	3.89	18.97	6.76	10.56	4.94
Nagaland local	1.40	4.48	17.75	6.48	11.67	5.77
Nadia	1.54	4.64	20.95	4.76	12.28	6.52
Surabhi	1.65	7.84	22.20	4.49	9.75	5.96

Gorubathan (Control)	1.60	5.57	23.00	6.07	10.98	5.40
S.Em (±)	0.043	0.062	0.230	0.073	0.138	0.065
CD at 5%	0.074	1.333	2.271	0.204	1.760	0.279

was found in genotypes Surabhi (9.75%) followed by Moran ada (9.89%) and Tripura local (10.56%). This finding is comparable with Saikia and Shadeque [39], who reported the moisture content was recorded in genotypes Thinglaidum (14.50%), Thingpuri (12.50%), Tura (12.80%), Nadia (12.50%) and minimum moisture content was found in Moran (9.50%) under Assam condition. Further, the highest Ash content was observed in Moran ada (7.25%) followed by Takeng local (7.07%) and Hui local (6.85%) compared to the lowest was obtained from the genotypes Tura local (4.00%) and Thinglaidum (4.41%). The results indicate that the Ash content of the ginger germplasms was low as compared to the earlier study [41]. In another study, it was observed that mature ginger rhizomes produced higher ash content of 7.48 % while tender ginger rhizomes produced lesser ash content of 3.80% [42]. Such evidence of variation in quality parameters under this present study is might be due to the different inherent genotypic characteristics of each germplasm, different agro-climatic conditions and cultural practices have a profound influence on determining the quality characteristics of ginger. Similar results were also observed in ginger [32,43].

4. CONCLUSION

The present study can be concluded that the genotypes viz., Surabhi, Gorubathan, Hui local, Thingria, Thinglaidum and Nadia showed a better performance and gave an appreciable higher amount of good quality content especially with essential oil oleoresin and dry recovery. Whereas, Takeng local, Moran ada and Meghalaya local showed lower quality content. Therefore, the former genotypes with better performance can be considered as a most suitable promising genotypes for improving quality production and processing under New Alluvial Zone of West Bengal.

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