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Standardization of method for peeling of fresh ginger rhizomes

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ABSTRACT: *India rank first in production of dry ginger. Peeling of ginger is an important step in dry ginger production. However, due to misshape and variability in shape of ginger the peeling on large scale became tedious. Hence an experiment was conducted to standardize the peeling method for peeling of fresh ginger during 2013-14 at Post Harvest Technology Unit, Department of Horticulture, College of Agriculture, Kolhapur.Among the different peeling methods, all the physical parameters like colour, moisture per cent and recovery of peeled ginger and chemical parameters like acidity, sugar, polyphenol, gingerol, oleoresin and crude fibrewere significantly influenced by different peeling methods. The ginger rhizomes peeled with enzymatic peeling followed chemical peeling recorded better recovery of gingerol, moisture per cent, oleoresin, polyphenol and crude fibre. Sensory evaluation of peeled ginger rhizomes was gradually highest for colour, taste, flavour and overall acceptability in the same treatment.*

Keywords *: Ginger, Chemical parameters, Peeling, Physical parameters.*

INTRODUCTION

Ginger (*Zingiber officinale Roscoe.)*, belonging to family Zingiberaceae, is a monocotyledonous tropical, herbaceous perennial plant grown for its pale-yellow pungent aromatic rhizomes. Indian ginger is characterized by pungency and typical lemony flavour and aroma with noted richness in oleoresins, essential oils and fibre contents. India rank first in production of dry ginger. Fully matured ginger rhizomes harvested at about 80–82% moisture content is used for making dry ginger. The fresh rhizomes are scraped with bamboo splits to remove theouter skin to accelerate drying process (Balakrishnan 2005) [4]. Traditionally, ginger is sun dried to safe moisture content of 10% by spreading it in single layer in open yard which takes 7–10 days for complete drying. The yield of dry ginger is 19–25% of fresh ginger depending on the variety and climaticzone (IISR 2005)[12].

The dry ginger so produced is known asthe rough or unbleached ginger and bulk of the gingerproduced in Kerala are of this quality. Kerala accounts forover 60% of the total dried ginger production and about 90%of India's ginger export trade (Madan 2005) [16]. It has long been used to treat many gastro-intestinal disorders and promoted as an effective antiemetic and carminative stimulator. Gingerols, the prime pungent principles in the ginger rhizome, have analgesic, antipyretic, anti-inflammatory, chemopreventive and antioxidant properties (Chen, *et al.,* 2011)[8]. Ginger, in recent years has gained considerable attention as a botanical dietary supplement for its use in treating chronic inflammatory conditions (Shukla and Singh, 2007) [24]. It is also used for curing arterial sclerosis, migraine headaches, rheumatoid arthritis, high cholesterol, ulcers and depression. Because of these properties, ginger and its derivatives like dried ginger, ginger oil, ginger flakes, powder, syrup and juice have lot of commercial applications in confectioneries, pharmaceuticals and beverage production.

The demand for ginger and its product at local and international market is so high that it was rated 10^{th} most important commodity in the world trade market level (Abdulkareem *et. al.*, 2011) [1]. During the processing of ginger peeling is one of the important operation. However, due to misshape and variability in shape of ginger the peeling on large scale became tedious. Hence an experiment was conducted to standardize the peeling method for peeling of fresh ginger.

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MATERIAL AND METHOD

The present research work on ginger was carried at Post Harvest Technology Unit, Department of Horticulture, College of Agriculture, Kolhapur during 2013-14. Freshly harvested ginger rhizomes of variety Mahim were obtained from progressive farmer of Umbraj District Satara. The experiment was laid out in completely randomized design with three replications and six treatments. The six peeling methods *viz*., Hand peeling with wooden knife/ splinter, Hand peeling with SS peeler, Traditional peeling (soaking in water for 24 hrs and rubbing), Lye peeling by using 1% NaOH at 80°C for 60 seconds, Enzyme peeling using 1% pectolytic enzyme at 40°C for 60 minutes and Enzymatic peeling followed by Chemical peeling were used for peeling of fresh ginger.

The rhizomes were washed in 200µl/l chlorine solution using a brush and were surface dried by using muslin cloth. The instruments and equipment's were presterilized with 100 ppm chlorine solution and dried. After weighing of fresh ginger peeling was carried out by using different equipments like wooden knife, SS peeler, and chemicals like CaO, 1% NaOH and pectolic enzyme. Fresh peeled gingers rhizomes were initially analyzed for physico-chemical parameters. The recovery of peeled ginger is calculated by taking initial weight and weight of the peel and expressed in percentage. The moisture percentage is calculated by on oven dry weight basis. The TSS of peeled ginger rhizome was estimated by using Erma Tokyo A°32 hand refractometer. The sample of peeled ginger was evaluated for colour, taste, flavour and overall acceptability by panel of judges based on rating with nine point Hedonic scale (Amerine *et al.* 1965). The acidity, total phenols, gingerol and crude fibre of fresh peeled ginger rhizome was determined as per method advocated by (A.O.A.C., 2005) [3] while total sugars were determined by method of Lane and Eynon (1960) [15] and as modified by Ranganna (1986) [22]. Oleoresin was extracted from the, dried and powdered rhizome in acetone. (Kizhakkayil and Sasikumar, 2009) [14]. The statistical analysis of data was carried out by analysis of variance method given by Panse and Sukhatme (1985) [18].

RESULTS AND DISCUSSION

The initial physico-chemical analysis of fresh raw ginger cv. Mahim (Table 1) revealed that fresh ginger rhizomes were light brown in colour with typical aroma. The fresh ginger rhizomes recorded 90.98 percent moisture content with 1.28 percent crude fibres. The TSS of fresh ginger was 6.10% with acidity 4.35 per cent. The fresh ginger used for experimentation showed 2.12 percent Total sugars, 2.03 per cent gingerol and 4.69 percent oleoresin content. The initial total Polyphenols content in fresh ginger was 83.02 mg/100 gm.

Table 1
Initial analysis of fresh ginger

Sr. No.	*Parameters*	*Characteristics/Content*
1	Moisture (%)	90.98
2	Crude fibre (%)	1.28
3	TSS (%)	6.10
4	Acidity (%)	4.35
5	Total sugars (%)	2.12
6	Gingerol (%)	2.03
7	Oleoresin (%)	4.69
8	Total Polyphenols (mg/100gm)	83.02
9	Colour	Bright yellow
10	Taste	Pungent
11	Flavour	Acceptable
12	Presence/absence of adhering material	Present

PHYSICAL PARAMETERS

The highest moisture percentage (87.89%) was observed in the treatment enzymatic peeling followed by chemical peeling. The moisture loss (3.09%) observed in enzymatic peeling followed by chemical peeling was least as compared to initial moisture content (90.98%). It was might be due to easily removal of peel of ginger while in other methods due to brushes it resulted into more loss of moisture. These results are in the line with Drooge and Lodewisk (1999)[10]. They tested the vapour vacuum peeling for removing the skin of fruits and vegetables by explosive vaporization of the moisture under the skin of fruits and vegetables. The loss of water is generally high after processing. Cutting and peeling of fruits and vegetables exposes interior tissues and dramatically increases the water evaporation rate (Brecht, 1995) [6].

The data on TSS was continuously decreasing from the treatment hand peeling with wooden splinter (6.09°Brix) to enzymatic peeling followed by chemical peeling (5.97°Brix). Itwas reduced may be due to complete removal of peel from ginger. The minimum recovery of peeled ginger (83.81%) was observed in the treatment enzymatic peeling followed by chemical peeling which was at par with the enzymatic peeling (85.60%). (Table 2) This showed that complete removal of peel of ginger. The

Table 2
Effect of different methods of peeling on physical parameters and cost of production peeled fresh ginger

Treatment		*Moisture*	*Recovery of peeled ginger (%)*	*TSS (°Brix)*	*Cost of production (Rs/kg)*
T_1	Hand peeling with wooden knife/splinter	85.66^{b}	87.16^{b}	6.09^{a}	14.47^{a}
T_2	Hand peeling with SS peeler	84.73^{bc}	87.04^{b}	6.06^{ab}	12.19^{b}
T_3	Traditional peeling (soaking in water for 24 hr and rubbing)	83.69^{c}	89.26^{a}	6.06^{ab}	13.20^{ab}
T_4	Lye peeling by using 1% NaOHat 80^0C for 60 seconds	85.12^{bc}	86.27^{b}	6.02^{bc}	8.72^{c}
T_5	Enzyme peeling by using 1 % pectolic enzyme at 40^0C for 60 minutes	86.32^{ab}	85.60^{bc}	5.98^{c}	8.93^{c}
T_6	Enzymatic peeling followed by chemical peeling	87.89^{a}	83.81^{c}	5.97^{c}	7.82^{c}
	GM	85.57	86.52	6.03	6.03
	SE (+)	0.577	0.634	0.018	0.018
	CD 5%	1.795	1.982	0.059	0.059

Table 3
Effect of different methods of peeling on sensory evaluation of peeled fresh ginger rhizome

Treatment		*Colour*	*Taste*	*Flavour*	*Overall acceptability*	*Adhering material*
T_1	Hand peeling with wooden knife/splinter	6.50	6.86	6.43	6.61	Present
T_2	Hand peeling with SS peeler	7.33	7.10	7.50	7.31	Present
T_3	Traditional peeling (soaking in water for 24hr and rubbing)	7.57	6.33	6.80	6.90	Present
T_4	Lye peeling by using 1%NaOHat 80^0C for 60 seconds	8.26	7.03	7.20	7.49	Partially present
T_5	Enzyme peeling by using 1% pectolytic enzyme at 40°C for 60 minutes	8.53	8.34	8.54	8.47	Partially present
T_6	Enzymatic peeling followed by chemical peeling	8.60^{a}	8.50^{a}	8.92^{a}	8.66^{a}	Absent
	G M	7.80	7.361	7.567	7.575	

significantly maximum recovery of peeled ginger was recorded in traditional peeling. This might be due to adhering of peel to the rhizomes. Srikaeo *et al.* (2011) [25] noted that there is potential for applying chemical or enzymatic peeling in an irregular shape vegetable like ginger. The unpeeled area under enzymatic peeling of ginger is reduced from 8.70% to 1.20% as compared to chemical peeling.The similar results are noticed by Ben-shalom *et al.* (1986) [5] and Pretel *et al.* (2007) [20] in citrus fruits.

CHEMICAL PARAMETERS

The effect of different peeling methods on acidity and total sugar was found to be non-significant. (Table 4) The maximum titerable acidity (4.32%) and total sugar (2.03%) was observed in hand peeling with wooden splinter. The highest crude fibre (1.17%) was recorded in the treatment enzymatic peeling followed by chemical peeling Similar results were reported by Douglas *et al.* (2005) [9] and Purseglove *et al.* (1981) [21] as removal of skin reduce the fibre content in ginger.

The highest gingerol (1.89%) and oleoresin (4.47%) was recorded in the treatment enzymatic peeling followed by chemical peeling while lowest gingerol (1.68%) and oleoresin (3.18%) was observed in the hand peeling with SS peeler. Due to damages during peeling to pith and removal of skin resulted into more loss of gingerol and oleoresin. The gingerol cells are located in the pith and cortex and they are independent from essential oil (Mangalakumari *et al.* 1984) [17]. The similar results were reported by Jayshree *et al.* (2012) [13]. According to them due to removal of skin in ginger it enhances the volatile oil loss through rupture of oil bearing cells which are present near the skin.Purseglove *et al.* (1981) [21] and Parthsarathy *et al.* (2008)[19] reported similar findings were as the extent of cleaning ginger rhizome prior to drying had a considerable influence on the volatile oil. The removal of skin enhances the volatile oil loss through rupture of oil bearing cells, which are present near the skin.

The content of phenolic compound are higher in peel of the rhizome. Due to complete removal of peel

Table 4
Effect of different methods of peeling on chemical parameters of fresh ginger rhizome

	Treatment	*Crude fibre (%)*	*Acidity (%)*	*Total sugars (%)*	*Gingerol (%)*	*Oleoresin (%)*	*Total polyphenols (mg/100gm.)*
T_1	Hand peeling with wooden knife/splinter	1.09^{bc}	4.32	2.03	1.72^{b}	3.40^{c}	31.82^{ab}
T_2	Hand peeling with SS peeler	1.00^{d}	4.29	2.01	1.68^{bc}	3.18^{d}	31.28^{ab}
T_3	Traditional peeling (soaking in water for 24 hr and rubbing)	1.05^{cd}	4.30	2.02	1.72^{b}	3.36^{c}	32.61^{a}
T_4	Lye peeling by using 1% NaOH at 80°C for 60 seconds	1.12^{ab}	4.25	1.98	1.86^{a}	4.28^{b}	31.21^{ab}
T_5	Enzyme peeling by using 1% pectolytic enzyme at 40°C for 60 minutes	1.10^{bc}	4.24	1.98	1.83^{a}	4.22^{b}	30.18^{bc}
T_6	Enzymatic peeling followed by chemical peeling	1.17^{a}	4.23	1.97	1.89^{a}	4.47^{a}	29.31^{c}
	GM	1.09	4.27	2.00	0.024	3.82	31.07
	SE (±)	0.02	0.176	0.030	0.076	0.043	0.595
	CD 5%	0.05	NS	NS	0.107	0.135	1.852

there may be lowest Total polyphenols in the treatment enzymatic peeling followed by chemical peeling. The similar results were reported by Henriquez *et al.* (2010) [11] in apple as the content of phenolic compounds are higher in apple peel compared to other edible part of fruits. These findings are in accordance with report reported by Cetkovic *et al.* (2012) [7]. The highest content of Total polyphenols compounds in the peel of tomatoes was confirmed. This implied that the removal of tomato skin generally reduce the level of Total polyphenols.

SENSORY EVALUATION

The highest score for colour (8.60), taste (8.50), flavor (8.92) and overall acceptability (8.66) were observed in the treatment enzymatic peeling followed by chemical peeling which was at par with enzymatic peeling. (Table 3) Adhering material of peel was absent in the treatment enzymatic peeling followed by chemical peeling while it is present in hand peeling with wooden splinter, SS peeler and traditional peeling. This might be due to complete removal of peel of ginger rhizomes in enzymatic peeling followed by chemical peeling which was recorded maximum score for as a (liked very much) in overall acceptability (Amerine *et al.*, 1965) [2].

COST OF PRODUCTION

The minimum cost of production was observed in the treatment of enzymatic peeling followed by chemical peeling. The maximum labours were required for hand peeling with wooden splinter which contributed to increase in the cost of production. However, in the enzymatic peeling followed by chemical peeling the peel was loosened which was removed easily with less labour. The results of present findings are case in conformity with results reported by Ravindran and Nirmal Babu (2005) [23] who worked out cost of peeling fresh ginger for preparation dried ginger.

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