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Suman
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Manisha Kaushal
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Anil Gupta
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Devina Vaidya
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Ranjan Kaushik
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Corresponding Author:
Manisha Kaushal
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Standardization of formulation for the preparation of ginger supplemented jelly candies

Suman, Manisha Kaushal, Anil Gupta, Devina Vaidya and Ranjan Kaushik

Abstract
Ginger is a spice and medicinal plant gaining attention in the pharmaceutical, food and chemical industries as being an excellent source of several bioactive phenolics. In this study, the ginger supplemented jelly candies were prepared by supplementing different concentrations of ginger powder, oleoresin and juice to it. The standardized formulation of jelly candies containing 3 percent ginger powder, 0.1 percent ginger oleoresin and 25 percent ginger juice were found better than the control recipes based on sensory evaluation. Nutritionally, the ginger supplemented jelly candies contained total phenols in the range of 6.98 to 10.32±0.13 mg/100g, antioxidant activity 37.31 to 43.12±0.17 per cent with maximum antioxidant activity (43.12±0.17 percent) in juice supplemented jelly candies. This clearly emphasizes the importance of ginger supplementation in confectionery products thereby enhancing the functional properties of the products. The energy value in control sample was 322.62±0.27 kcal/g followed by 326.80±0.32 kcal/g in oleoresin, 332.45±0.35 kcal/g in powder and 336.83±0.24 kcal/g in juice supplemented jelly candies. No apparent growth of mould, yeast and bacteria was detected in ginger supplemented jelly candies, which showed that the products were safe for consumption. Thus, the commercial adoption of this technology seems to be a profitable venture for utilization of ginger thereby minimizing the postharvest losses and providing new products for the market.

Keywords: Jelly candies, oleoresin, ginger supplemented, texture

Introduction
A confectionery gel consists of high sugar components of sucrose and glucose syrup, combined with gelling components such as starch, gelatin, or pectin, along with food acid, flavourings and colourings (Marfil *et al.* 2012; Burey *et al.* 2009) [15, 7]. Soft jelly is characterized by a soft and chewy texture typically conferred by a gelatin or pectin-based gel (Fisher, 2011) [9]. Common confectionery gel products include "jelly snakes," "jelly babies," and "jelly beans". Soft jelly is characterized by a soft and chewy texture typically conferred by a gelatin or pectin-based gel (Fisher, 2011) [9]. Utomo *et al.* (2014) [25] stated that chewy candies made with different gelling agents and sweeteners offer certain/specific texture characteristics and eating properties. The choice of gelling agent can have the biggest impact on final product quality and attributes, and therefore must receive special attention. Gelatin, the traditional gelling agent used in gummy formulations, is losing flavour due to cultural, dietary, and safety concerns (Lennox, 2002; McHugh, 2003) [14, 16], as well as the desire for unique textural properties (Poppe, 1995) [20]. Ginger (*Zingiber officinale* Roscoe, Zingiberaceae) is one of the most important cash crop and principal spice of India and abroad (Bartley and Jacobs, 2000) [5] and is a native plant of Asia but is also cultivated in West Indies, Africa, India and many other tropical countries of the world (Singletary, 2010) [23]. In India, ginger is grown in an area of 165 thousand hectares with a production of 1109 thousand tonnes (FAO, 2018) [8]. In Himachal Pradesh, ginger is grown in the mid hill regions covering an area of 3.2 thousand hectares with a production of 7.6 thousand tonnes (Kaushal *et al.* 2017) [13]. Owing to the presence of polyphenols, terpenoids, isoterpenoid compounds i.e. gingerol and its derivatives, ginger is effective against several pharmacological actions and has been widely used all over the world for a wide array of unrelated ailments including arthritis, cramps, rheumatism, sprains, sore throats, muscular aches, pains, constipation, vomiting, hypertension, indigestion, dementia, fever and infectious diseases (Ali *et al.* 2008; Tan and Vanitha, 2004; Badreldin *et al*, 2008; Radhika *et al* 2017) [1, 24, 4, 22]. It is widely used around the world in food as a spice both in fresh and dried form, which adds flavour to the meal by creating spicy pungent taste (Jayashree *et al.* 2014) [12]. Ginger is presently used in various forms like fresh, dried as sonth and ginger powder, pickles, ginger preserves or candies, ginger juice for making squashes, appetizers etc (Peter, 1996) [19].

Consequently, a very few ginger based products *viz*. candy, tonic and syrup are available in the market (Nath *et al*., 2013; Radhika *et al*., 2017) [17, 22]. The dried ginger is traded internationally for the manufacture of essential oil and oleoresins, utilized for the preparation of non-alcoholic beverages and vitaminised effervescent soft drinks (Peter, 1999) [18].

However due to pungent aroma and sharp spicy flavor, there are limited opportunities to develop processed food products from ginger. Keeping in mind the medicinal and therapeutic properties of ginger rhizomes and the present status of confectionary industry in India, ginger supplemented jelly candies were developed.

Materials and Methods

Procurement of raw material: Raw material such as fresh ginger rhizome (cv. Himgiri) used for conducting study were procured from local market, honey was procured from the Department of Entomology, UHF, Nauni, Solan (HP). Different ingredients like sugar, glucose syrup, pectin, etc. were procured from the local market.

Standardization of formulation for the preparation of ginger supplemented jelly candies: Jelly candies were prepared by following the recipe (R_J) given by Priya and Prakash (2016) by incorporating different concentration of ginger for value addition and quality improvement. The general procedure for the preparation of jelly candy involved heating the water with the addition of commercial pectin (100 Grade) and sugar (3/4th of total) along with tri-sodium citrate. The addition of sugar with pectin avoids lump formation, while tri-sodium citrate which is sodium salt of citric acid acts as a buffering or emulsifying agent. The next step was to cook the jelly base until the ingredients get thoroughly mixed followed by addition of remaining sugar and glucose syrup up to a soluble solid content of 75ºB measured by using a hand held model Erma hand refractometer (58-92ºB range). The formulation consists of pectin 1.20g, sucrose 46.29g, glucose syrup 30.55g, water 20.37ml, tri-sodium citrate 0.30g and 1.38 ml of 50% citric acid solution. Prior to molding, the mixture was cooled to around 65-70ºC and adjusted to pH values 3.2 to 3.5 using 50 per cent (w/v) citric acid solution. The addition of citric acid initiates gel formation. The final mixture was then poured into rectangular shaped mold of $2\times1\times1cm^3$ and allowed to cool and set at room temperature.

The ginger powder in varying concentrations (1 to 6%) and ginger oleoresin (0.02 to 0.14%) was added after TSS reached 75ºB for the development of ginger powder supplemented jelly candies. Similar to the above procedure the ginger juice supplemented jelly candies were prepared by excluding water from recipe and adding ginger juice in different concentration varying from 5 to 30 per cent.

Physico-chemical characteristics: Ginger supplemented jelly candies were analysed for their weight and dimensions. Water activity (a_W) was estimated by Computer Digital Water Activity Meter (HW_3 model, Rotronic International, Switzerland). Moisture, total sugars, reducing sugars, ash, total phenol, antioxidant activity, and energy was estimated using standard methods (AOAC, 2004) [3]. The firmness and springiness of jelly candies was measured according to the modified method of Bourne (2002) [6]. The universal stable texture analyser TAXT2i (Stable 70 Microsystems, UK) was used for texture analysis. Probe P/2N needle was used for testing penetration force. Test parameters analyzed were firmness and springiness. Force calibration of the instrument was done prior to start of the experiment to minimize measurement error. The instrument was operated at pre-test speed = 1.00 mm/s, test speed = 1 mm/s, post-test speed = 10 mm/s, distance = 5 mm, trigger force = 5 g, force and data acquisition rate of 100 pps.

Sensory evaluation: **S**ensory evaluation of ginger supplemented jelly candies was carried out according to Amerine *et al*. (1965) [2]. The jelly candies were evaluated by panel of 7-9 judges where each sample was evaluated for various quality attributes *viz*. colour, texture, aroma, taste and overall acceptability on 9-point Hedonic Scale.

Cost of production: Cost of production of ginger supplemented jelly candies prepared from ginger powder, juice and oleoresin was calculated by taking into consideration various input costs such as cost of raw material, labour, processing cost, packaging and other charges. For calculating the price of product, 20 per cent profit margin was added to the cost of production of each product.

Result and Discussion

Standardization of formulation for the preparation of jelly candies supplemented with ginger powder, juice and oleoresin

Jelly candies were prepared by the recipe (R_J) given in Table 1 with the supplementation of ginger powder, oleoresin and juice at varying concentrations. The results pertaining to the standardization of formulation with different concentration of ginger powder for the preparation of ginger powder supplemented jelly candies presented in Fig. 1 showed the significantly higher scores for different parameters such as colour (8.0), texture (7.8), taste (8.4), aroma (8.1), and overall acceptability (8.0) was received by treatment T_4R_J having 3.0 per cent ginger powder. Among the different ginger powder supplemented lollipops the treatment combination T_7R_J (6% ginger powder) was least preferred for taste and overall acceptability although none of the concentrations were rejected by the panelists. The panelists due to characteristic taste, colour and flavour of the product liked the increasing concentration of ginger powder up to 3.0 per cent.

Thus, the combination of ginger powder (3%) in the recipe (R_J) was rated superior to other combinations.

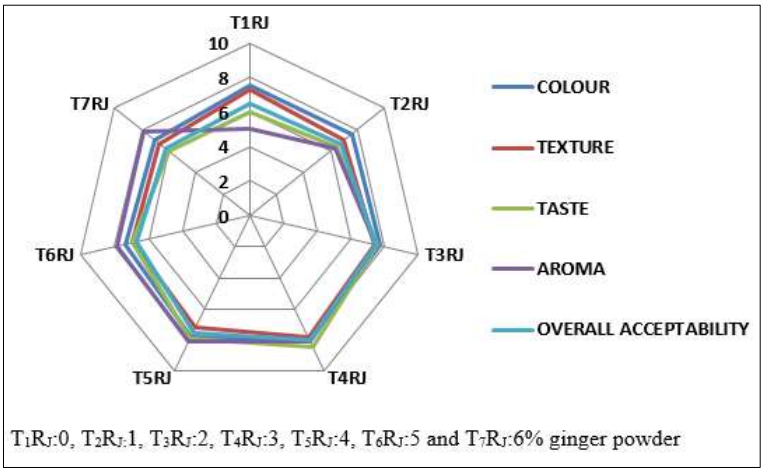

Fig 1: Sensory scores of different formulations of ginger powder supplemented jelly candies

Further, the results pertaining to standardization of formulation with different oleoresin concentrations showed that treatment combination (O_5R_J) containing 0.10 per cent ginger oleoresin with recipe R_J scored higher scores for colour (8.2), texture (8.0), taste (7.8), aroma (8.2) and overall acceptability (8.1), while O_7R_J (0.14% ginger oleoresin in recipe R_J) scored least scores for different parameters due to increased pungency and bitterness contributed by ginger oleoresin in the jelly candies (Fig 2).

Similar to the above procedure the ginger juice supplemented jelly candies were prepared by excluding water completely and adding ginger juice in different concentration varying from 5 to 30 per cent in the recipe R_J. Different combinations of ginger juice supplemented jelly candies were organoleptically evaluated (Fig. 3) and treatment combination T_5R_J containing 25 per cent ginger juice in recipe R_J scored highest scores for colour (8.3), texture (8.3), taste (8.5), aroma (8.2) and overall acceptability (8.5).

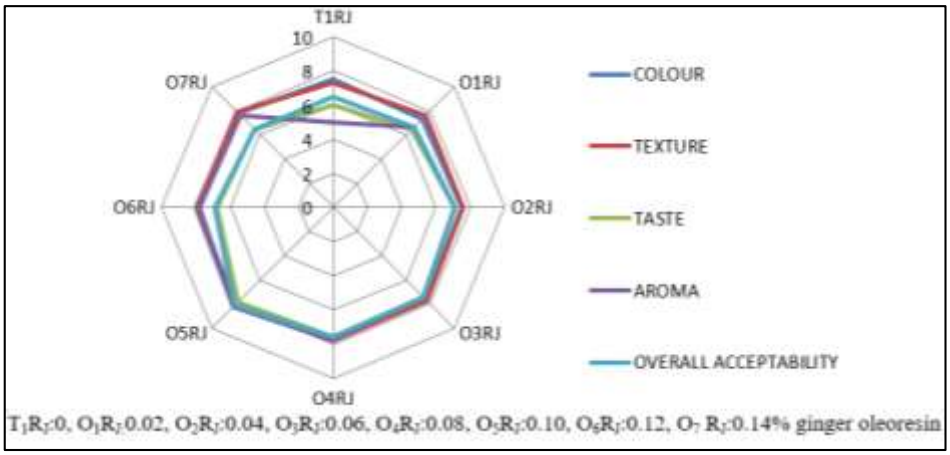

Fig 2: Sensory scores of different formulations of ginger oleoresin supplemented jelly candies

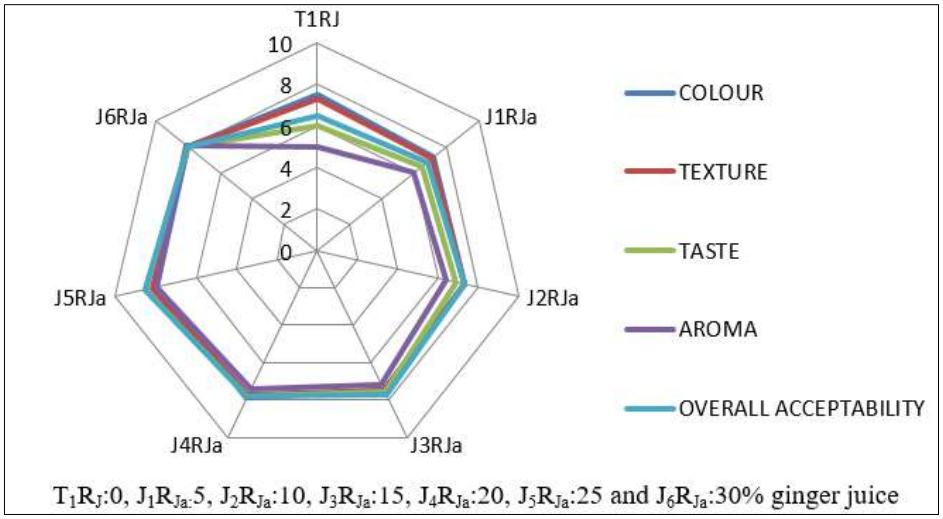

Fig 3: Sensory scores of different formulations of ginger juice supplemented jelly candies

Thus, the combination of ginger juice (25%) and the recipe (R_J) was rated superior to other combinations

Physico-chemical characteristics of ginger supplemented jelly candies

The perusal of data on the physico-chemical characteristics of standardized formulation of ginger supplemented jelly candies comparing with control is shown in Table 1. Jelly candies prepared had mean weight of 2.60±0.04g and length of 20.0±0.01 mm and breadth of 10.0±0.02 mm with height of 10.0±0.03 mm irrespective of the treatments. The moisture content in ginger supplemented jelly candies was observed as 11.95±0.02 per cent in powder, 11.98±0.03 per cent in oleoresin and 11.97±0.04 per cent in juice-supplemented lollipops as against 12.02±0.04 per cent in control. Similar trend was observed in water activity where a_w of 0.679±0.002 was observed in powder, 0.701±0.001 in oleoresin and 0.697±0.002 in juice supplemented jelly candies as against 0.703 ±0.003 in control lollipops. All the treatments of jelly candies showed pH in the range 3.32-3.42, which is ideal for gel formation.

Table 1: Physico-chemical characteristics of ginger supplemented jelly candies

S. No.	Parameters	Control	Powder Jelly Candies	Oleoresin Jelly Candies	Juice Jelly Candies
1	Weight (g)	2.60±0.04	2.63±0.04	2.60±0.04	2.62±0.04
2	Length (mm)	20±0.01	20±0.01	20±0.01	20±0.01
3	Breadth (mm)	10±0.02	10±0.02	10±0.02	10±0.02
4	Height (mm)	10±0.03	10±0.03	10±0.03	10±0.03
5	Moisture (%)	12.02±0.04	11.95±0.02	11.98±0.03	11.97±0.04
6	Water activity	0.703±0.003	0.679±0.002	0.701±0.001	0.697±0.002
7	Total Sugars (%)	63.10±0.12	62.12±0.10	62.80±0.14	62.00±0.22
8	Reducing sugars (%)	15.70±0.13	14.01±0.11	15.12±0.21	14.00±0.12
9	pH	3.32±0.02	3.41±0.03	3.32±0.01	3.42±0.04
10	Total phenols (mg/100g)	4.46±0.12	8.67±0.14	6.98±0.11	10.32±0.13
11	Antioxidant Activity (%)	32.30±0.12	40.22±0.21	37.31±0.13	43.12±0.17
12	Total Ash (%)	0.24±0.03	0.44±0.02	0.28±0.02	0.40±0.04
13	Energy value(cal/g)	322.62±0.27	332.45±0.35	326.80±0.32	336.83±0.24

*All values are mean of 3 observations; * SD = Standard deviation

Nutritionally, ginger supplemented jelly candies contained total phenols in the range of 6.98±0.14 to 10.32±0.13 mg/100g as compared to control, which had total phenolic content of 4.46±0.12 mg/100g. Similarly, antioxidant activity was found to be in the range of 37.31±0.13 to 43.12±0.17 per cent with maximum antioxidant activity (43.12±0.17%) in juice supplemented jelly candies and minimum in control jelly candies which has an antioxidant activity of 32.30±0.12 per cent. This clearly emphasizes the importance of ginger supplementation in confectionery products thereby enhancing the functional properties of the products. The mean total and reducing sugars recorded in control and ginger supplemented jelly candies were in the range of 62.00±0.22 to 63.10±0.12 per cent and 14.00±0.12 to 15.70±0.13 per cent. Total ash representing the mineral content was found to be 0.24±0.03 per cent in control which increased in ginger supplemented jelly candies as 0.44±0.02 per cent in powder, 0.40±0.04 per cent in juice and 0.28±0.02 per cent in oleoresin supplemented jelly candies. The values signify the enhancement of mineral content in the ginger supplemented jelly candies. The energy value in control sample was 322.62±0.27 kcal/g followed by 326.80±0.32 kcal/g in oleoresin, 332.45±0.35 kcal/g in powder and 336.83±0.24 kcal/g in juice supplemented jelly candies.

Thus, it concludes that the ginger powder, oleoresin and juice can be added in jelly candies to make them enriched in functional components.

Texture profile of jelly candies

The control and ginger supplemented jelly candies were subjected to penetration test using the P/2N needle probe. The results of penetration test are depicted in Fig. 4 and Table 2, which represents the effect of ginger supplementation on the texture profile of jelly candies.

Table 3: Effect of ginger supplementation on the texture profile of jelly candies

Samples	Firmness (g)	Springiness (%)
T_1 Control	26.53	9.87
T_2 Powder supplemented	21.63	12.63
T_3 Oleoresin supplemented	18.33	17.39
T_4 juice supplemented	18.10	10.69

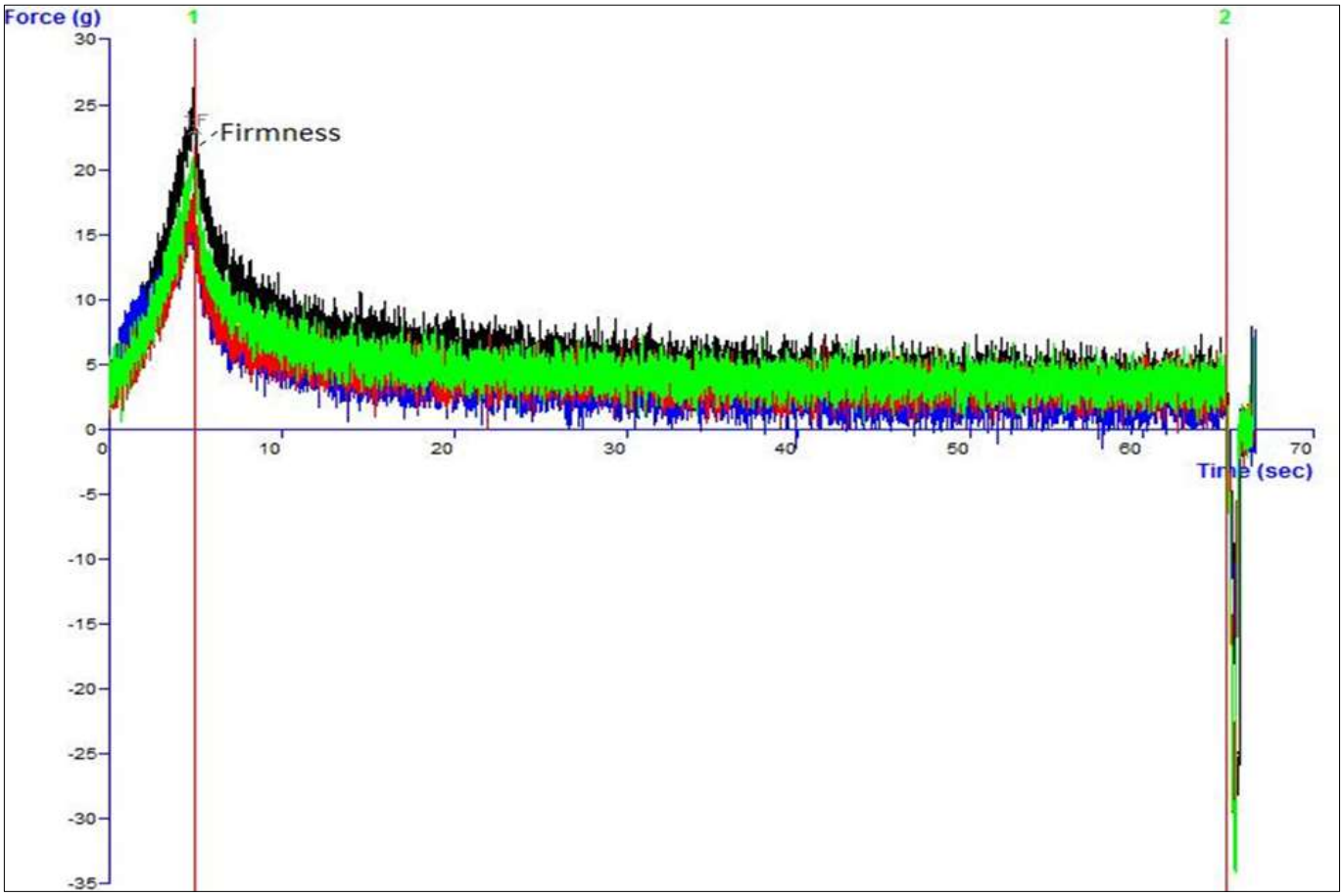

Fig 4: Texture profile of control and ginger supplemented jelly candies

The firmness values were lower (18.10-21.63g) in all the treatments as compared to the control (26.53g). The springiness was found lowest in the control (9.87%) and maximum in oleoresin with the value of 17.39 per cent. Similar types of results were observed by Hani *et al*. (2015) and Habilla and Cheng (2015). They reported that the hardness and gumminess decreased with increasing fruit puree content in gummy confections. The addition of fruit puree provided more heterogeneity to network structure and thus contributed to lower firmness values.

Cost of production

Cost of production of ginger supplemented jelly candies was found Rs. 78.91 (powder supplemented), 108.46 (oleoresin supplemented) and 79.78 (juice supplemented) per 100 jelly candies after adding 20 per cent profit. The cost of these jelly candies was lower than the market rate of jelly candies. Thus, the product was found to be economical and nutritional.

Conclusion

From the above study, it can be concluded that the Indian confectionery is one of the fastest growing sectors in the world, which requires substantial change in its chemical composition. Thus the present study concludes that addition of healthful ingredients like ginger in the form of powder, oleoresin or juice and honey can certainly enhance the nutritional profile of the confectionery products like jelly candies. Thus, the commercial adoption of this technology seems to be a profitable venture for utilization of ginger thereby minimizing the postharvest losses and providing new products for the market.

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