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SK Mastud
Department of Technology, Shivaji University, Kolhapur, Maharashtra, India

GV Mote
Department of Technology, Shivaji University, Kolhapur, Maharashtra, India

AK Sahoo
Department of Technology, Shivaji University, Kolhapur, Maharashtra, India

Correspondence
SK Mastud
Department of Technology, Shivaji University, Kolhapur, Maharashtra, India

Development of value added products by using purslane (*Portulaca oleracea*)

SK Mastud, GV Mote and AK Sahoo

Abstract
A study was conducted to develop purslane powder from purslane and utilizing the purslane powder for the development of ice-cream and cookies. Today foods are not intended to only satisfy hunger and to provide necessary nutrients for humans but, also to prevent nutrition-related diseases and improve physical and mental well-being of the consumers. In this regard, functional foods play an outstanding role. Purslane is globally used both as a vegetable and as an herb for medical and therapeutic purposes. Purslane powder is prepared by using tray dryer at 60ºC temperature. Prepared purslane powder was evaluated for chemical analysis. Purslane powder added in ice-cream and cookies were formulated with 1, 2, 3gm and 2, 4, 6, 8gm addition respectively. Now the experimental result revealed that purslane powder added ice-cream and cookies contains significant amount of protein and antioxidants with potential health benefits and nutritional characteristics. Sensory evaluations of all developed ice-cream and cookies were also carried out and it was found that 2gm purslane powder in ice- cream and 6gm of purslane powder in cookies formulation was acceptable. Therefore 2gm purslane powder in ice-cream and 6gm purslane powder in cookies proves enhanced nutritional properties, physicochemical characteristics and organoleptic attributes.

Keywords: purslane powder, ice-cream, cookies

1. Introduction
Purslane is a common herb used as vegetable. Its vernacular name is purslane, kurfa or hog weed. The plant belongs to division Magnoliophyta, class magnoliopsida, subclass caryophyllidae, order Caryophyllales. Its family, genus and species are Portulacaceae, *Potulaca* and *oleracea*, respectively (Shazia Syed *et al*., 2016) [11].
Purslane is a well-known edible plant, widespread in temperate and tropical regions of the world. It is an herbaceous and annually plant with a fleshy stem and thick, green, succulent leaves and small black seeds that have medicinal properties. Purslane is listed by the World Health Organization as one of the most used medicinal plants and it has been given the term Global Panacea. It has been described as a Power Food of the future because of its high nutritive and high antioxidant properties. From the point of view of traditional medicine, the nature of purslane is cold and wet, astringent and diuretic, bile anodyne that relieves temperature of blood, liver and stomach. It is useful in the elimination of headaches, thirst relief, stoppage of bleeding, crushing of bladder stones and reduction of coughing and irritation of urethra, bladder, intestines, and hemorrhoids and used as a health food for patients with cardiovascular diseases. The methanolic extract of purslane was found to exhibit moderate antimicrobial activity against *Bacillus subtilis*, which referred to a monoterpene glucoside named portuloside A (Khaled M. Youssef and Sayed M. Mokhtar., 2014) [12].
Ice-creams is a frozen food made from milk fat, milk solids-not-fat, sweeteners, and flavorings; a variety of fruits, nuts, and other items also may be added. Ice-creams in the United States has a legal definition, which can be found in the Code of Federal Regulations, which specifies solids, fat, and air contents. These specifications state that vanilla ice-creams must contain a minimum of 10% milk fat by weight, a minimum of 20% milk solids and at least 192g of total food solids per liter of ice-creams, with each liter of ice-creams weighing a minimum of 540g. Other ice-creams categories exist, such as reduced calorie ice-creams, which in the United States must meet the nutrient claims that comply with "reduced fat". These legal requirements often dictate the types and ratios of ingredients used in frozen desserts as well as some of the processing conditions. Because minimum contents (except air content) normally are stated in the federal requirements, commercial ice-creams vary considerably in body, flavor, melt, and texture characteristics. Recent statistics have shown that 61% of all frozen dessert products manufactured in the United States fall into the ice-creams category and 26% into the nonfat and low fat ice-creams category. The remaining portions of frozen dessert

products consist of frozen yogurt (5%), water ices (4%), sherbets (3%), and other (1%) categories (Arbuckle, W. S., 2013) [2].

The word cookie refers to "small cakes" derived from the Dutch word "koekje" or "koekie." Cookies contain many of the same ingredients as cakes except that they have a lower proportion of liquid with a higher proportion of sugar and fat to flour. Cookie recipes can be prepared in myriad shapes, flavors and textures, and can be decorated**.** Every country seems to have its favorite in North America it's the chocolate chip in the United Kingdom its shortbread in France, it's sables and macrons and it's biscotti in Italy. Cookies can be baked or called no-bake, where they can be made from ready-to-eat cereals, such as Rice Krispies Treats, oatmeal, nuts, dry fruit, or coconut, and held together with a cooked syrup (Kukade, A. G. 2017) [5].

2. Materials and Methods

2.1 Raw material

Fresh Purslane (*Portulaca oleracea*) plants were harvested from private fields from karmala.

2.2 Chemicals

Most of the chemicals used in this investigation were of analytical grade and were obtained from Food Technology Laboratory of Department of Technology, Shivaji University, Kolhapur.

2.3 Preparation of purslane powder

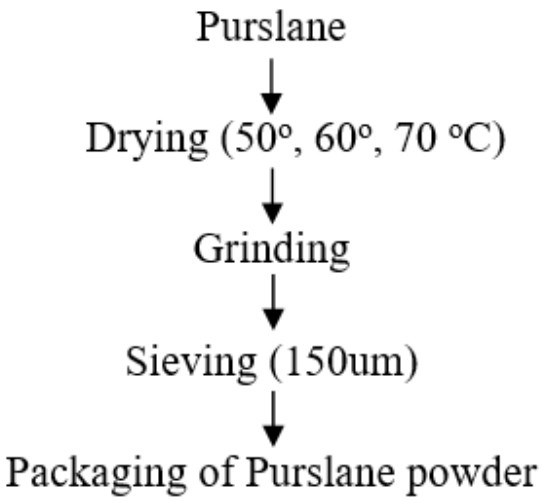

Fig 1: Preparation of purslane powder

Cabinate tray dryer was used on a laboratory scale to achieve drying of purslane. Tray dryer was set at a constant air velocity of 2m/s, and drying was carried out first at 50 ˚C, followed by 60 ˚C and 70 ˚C. After 30 minutes of turning on the system, drying was carried out. Tray was placed inside the dryer where temperature was set accurately first at 50 ˚C, followed by 60 ˚C and 70 ˚C. Weight was measured with the interval difference of 30 minutes in two consecutive weighing. Drying process of purslane powder carried out at 60 ˚C for 10 hours was selected because of acceptable appearance.

2.4 Preparation of Ice-creams

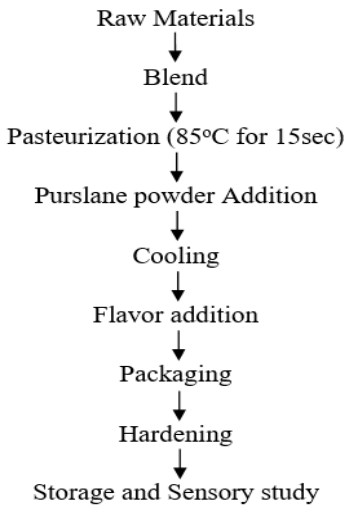

Fig 2: Preparation of purslane powder fortified ice-creams (*fssai* Milk and Milk products 2015).

Ice-creams was prepared using 10% sugar, 24% cream (40% fat), 60.5 % Milk (4% fat), 0.5% stabilizers (CMC 0.2% and Guar gum 0.3%) formulated by (*fssai* dairy manual 2010). The mixture was blend and pasteurized at 65 ˚C for 15 min. then cooled and prepared. 5gm sugar and Purslane powder (1, 2 and 3gm) mix with water at 40 ˚C and made syrup that mixture add in ice-creams mixture and then add flavour. Then taken 4 hrs for ageing, after ageing ice-creams mix was aerated using blender for 30 min. and then packaged and kept in deep freezer (below about -25 ˚C) for hardening.

Table 1: Formulation of Ice-creams

Ice-creams Sample code	Milk (ml)	Cream (gm)	Sugar (gm)	Stabilizer (gm)	Purslane Powder (gm)
Control	60.5	24	10	0.5	0
S_1	60.5	24	10	0.5	1
S_2	60.5	24	10	0.5	2
S_3	60.5	24	10	0.5	3

2.5 Preparation of Cookies

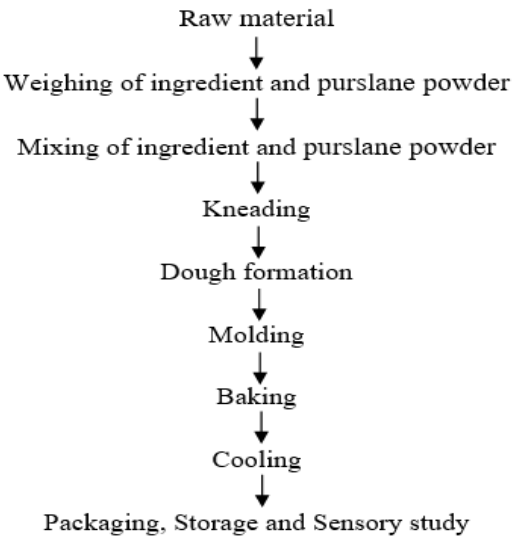

Fig 3: Preparation of purslane powder fortified cookies (Matz, S. A. 1992) [7].

Cookies was prepared using refined wheat flour (RWF), Baking Powder, Hydrogenated vegetable oil (HVO), Water, Salt and sugar powder with slight modification of process author (Matz, S. A. 1992) [7]. Purslane powder was added 0, 2, 4, 6 and 8gm w/w refined wheat flour replaced using purslane powder in cookies.

Table 2: Formulation of Cookies

Cookies Sample	RWF (gm)	Sugar Powder (gm)	HVO (gm)	Water (ml)	Baking Powder (gm)	Salt (gm)	Purslane Powder (gm)
Control	100	50	50	15	1	0.5	0
C_1	98	50	50	15	1	0.5	2
C_2	96	50	50	15	1	0.5	4
C_3	94	50	50	15	1	0.5	6
C_4	92	50	50	15	1	0.5	8

2.6 Physicochemical analysis of Purslane powder, Ice-cream and Cookies

2.6.1 Physical analysis

The analytical equipments included are Digital model of Vernier caliper for thickness, length, Width, an electronic balance with the accuracy of 0.0001g for weight measurements, spectrophotometer (model UV-2800) for estimation of total phenolic compound, antioxidant activity. Texture analysis is done by texturizer (Hunter color lab at ICT Mumbai).

2.6.1.1 Water Activity

Water activity of purslane powder was measured using the Aqua Lab water activity meter.

2.6.1.2 Particle Size

Powder is passed through the sieve to obtain uniform size

2.6.1.3 Bulk Density

Bulk density is not an intrinsic property of a material; it can change depending on how the material is handled. For example, a powder poured into a cylinder will have a particular bulk density; if the cylinder is disturbed, the powder particles will move and usually settle closer together, resulting in a higher bulk density. For this reason, the bulk density of powders is usually reported both as "freely settled" (or "poured" density) and "tapped" density (where the tapped density refers to the bulk density of the powder after a specified compaction process, usually involving vibration of the container.) Weight of a unit volume of a loose material (such as a powder or soil) to the same volume of water, expressed in kilograms per cubic meter (kg/m3), (Garg 2012) [6].

2.6.1.4 Water absorption capacity

Water absorption capacity indicated the how much water absorbed or hold by material. It's determined by simple method, 1gm of sample per ml of water absorbed. It is also known as water binding capacity of sample and useful to retain the water in food products and given the fruity texture to food material, (Garg., 2012) [6].

2.6.1.5 Over-run of Ice-creams

Overrun is the term for the percent of expansion of ice cream achieved from the amount of air incorporated into the product during the freezing process. An overrun of 50% means that it has expanded 50% (for example: one gallon of mix will make one and a half gallons of finished product). "Gravity" fed units typically yield on average about 35% overrun. "Pressurized" units can yield 65% overrun or greater. Over-run of Ice-creams was determined by using given formula, (*fssai* Milk and milk products 2015) [4].

$$\text{Over-run of Ice-cream} = \frac{\text{Volume - Weight}}{\text{Weight}} \text{ X } 100$$

2.6.1.6 Melting rate of Ice-creams

The melting rate was determined according to the method described by Prindiville *et al.,* (2000) [9]. The ice-creams samples were weighed in plastic cups and stored at -18 °C for 2 weeks were evaluated. Pre-weighed ice-creams samples (70 g) were carefully removed from the plastic cups and placed on a wire mesh (1 cm^2), and a previously weighed beaker was placed beneath the mesh to collect the melted ice cream. The system was kept at 24 °C ± 1 °C. After 30 min, the beaker with the melted ice cream was replaced with another one and weighed. This process was repeated at 10-min intervals up to 70 min. The assay was performed in triplicate for all samples. The melting profiles were plotted as the ratio of the weight of drained ice cream to the weight of the original sample versus time.

2.6.2 Chemical analysis

Chemical Analysis includes Moisture, Ash, Fat, Crude fibre, Carbohydrates and Protein were estimated by standard methods (AOAC, 2000) [1].

2.6.2.1 Analysis of bioactive compounds

2.6.2.1.1 Sample extraction

The extract for determination the contents of total phenolics and antioxidant capacity of dried purslane leaves was prepared according to the method described by Barros *et al*., 2011 [3] with some modifications as follows: one gram of minced fresh leaves or fine dried powder was stirred with 25 ml of methanol at 100 rpm on Orbital Shaker (LAB-LINE Instruments, Inc., USA) for 1 hr at room temperature (35 ±2 °C) and filtered through filter paper No. 102. The residue was then re-extracted with 25 ml of methanol. The methanol extracts were combined and stored at 4 °C till further analyses. The extract was diluted if necessary.

2.6.2.1.2 Determination of % radical scavenging activity (antioxidant activity)

The antioxidant activity of the extract was measured by DPPH assay described by Ravichandran *et al*., 2013 as follows: 0.1 ml of the methanol extracts was mixed for 30 s with 3.9 ml of DPPH solution (6 x 10^{-5} M). The solution was incubated at room temperature for 30 min, and the decrease in absorbance at 515 nm was measured at the end of incubation period with a spectrophotometer. The DPPH solution without extract was analyzed as control. The antioxidant activity was calculated as follows:

$$\% \text{ Inhibition} = \frac{\text{Absorbance of control} - \text{Absorbance of test sample}}{\text{Absorbance of control}} \text{ X } 100$$

2.6.2.1.3 Total Phenolic Content (TPC)

Total phenolics content was evaluated in the methanolic extracts, according to the Folin-Ciocalteu method with slight modifications (Barros L *et al.*, 2011) [3] One ml aliquot of the extract was mixed with 5 ml of Folin–Ciocalteu phenol reagent (diluted with water 1:10 v/v) and 4 ml of sodium

carbonate (75 g/ L). The tubes were vortexed for 30 s and allowed to stand for 60 min at room temperature (35 ±2°C) for color development. The absorbance was measured at 765 nm by spectrophotometer. A calibration curve (R2= 9995) of gallic acid (0-0.10 mg/ ml) was prepared and tested under similar conditions. The results were expressed as mg of gallic acid equivalents per 100 g of dry weight (mg GAE/ 100 g DW). All samples were analyzed trice and the results averaged.

2.7 Sensory Evaluation of Ice-creams and Cookies

Sensory, evaluation of ice-creams and cookies samples were done by using nine point hedonic scales by 15 semi-trained members, (Peryam *et al.*, 1957) [8].

3. Results and Discussion

3.1 Physicochemical Analysis of Purslane powder

3.1.1 Chemical Analysis of Purslane powder

The chemical composition of the purslane powder revealed that it was a good source of crude fiber (4.5 ±0.01%) and protein (16.38 ±0.05%). Purslane contains 4.20 ±0.01% moisture, 18.20 ±0.50%, ash, 2.33 ±0.70% fat, 58.89% carbohydrate.

Table 3: Chemical analysis of purslane powder

Parameters	Values
Moisture (%)	4.20 ±0.01
Ash (%)	18.20 ±0.50
Protein (%)	16.38 ±0.05
Crude Fat (%)	2.33 ±0.70
Carbohydrate (%)	58.89
Crude fiber (%)	4.5 ±0.10
Total Phenolic compound (mgGAE/100g)	179.89 ±0.03
Antioxidant (%RSA)	89.21 ±0.05

3.1.2 Physical properties of purslane powder

The physical properties such as average particle size, bulk density and water absorption capacity of optimized powder were measured and given in, (Table 4). Average particle size of purslane powder obtained by plotting the values on semi-log graph paper and value calculated was 150 ±1.00um. Particle size readily affect on product on product's rheological, structural and sensory attributes. Purslane powder has fine texture and can be used as food ingredients. Bulk density is not an intrinsic property of a material; it can change depending on how the material handled. The packaging material selection, transportation and storage condition depends on bulk density. Bulk density of purslane powder was 0.75 ±0.03 g/cm^3. Water absorption capacity (WAC) indicates, the how much water absorbed or hold by material. Water absorption capacity purslane powder was 8.19 ±0.50ml/gm.

Table 4: Physical analysis of purslane powder

Parameters	Values
Bulk Density(g/cm^3)	0.75 ±0.03
Particle size(um)	150 ±1.00
WAC (ml/gm)	8.19 ±0.50

3.2 Utilization of purslane powder

3.2.1 Utilization of purslane powder in ice-creams

In purslane fortified ice-creams, appearance liking and overall liking among the control, 1, 2 and 3gm purslane prepared samples were scored differently by the panellists, (Fig 4). However, 3gm purslane powder fortified ice-creams sample received lower score, on taste, flavour, mouth feel, appearance and overall acceptability liking. The all over scores showed that 2gm purslane powder fortified ice-creams sample was the closest to "just a outright". Some panellists indicated their appreciation on the nutritional value of 2gm purslane powder fortified ice-creams.

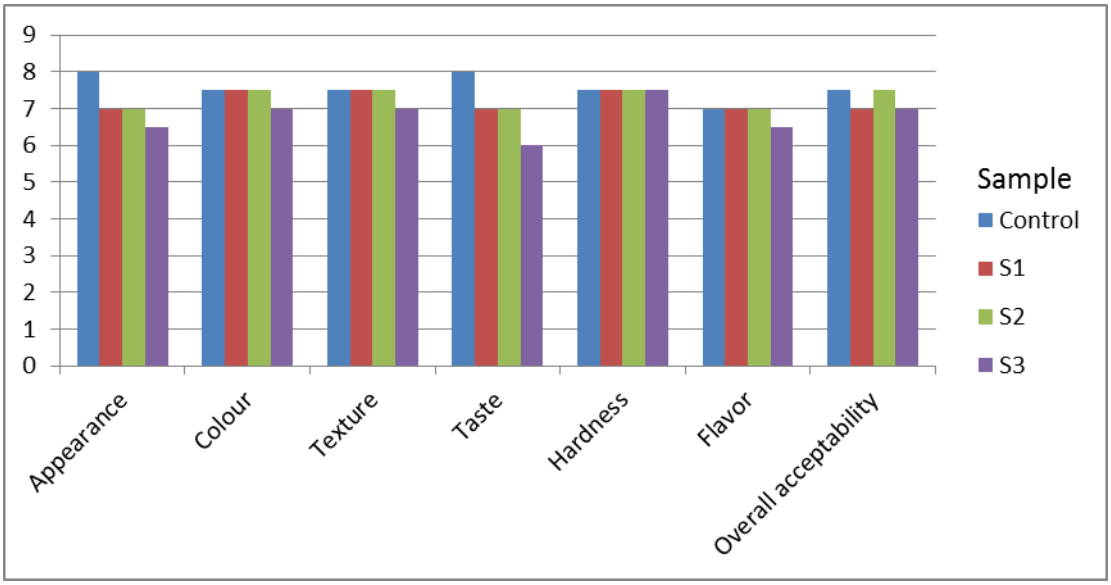

Fig 4: Sensory evaluation of Ice-creams

3.2.1.2 Over-run and Melting rate of Ice-creams

Overrun is the term for the percent of expansion of ice-creams achieved from the amount of air incorporated into the product during the freezing process. Overrun and melting are associated with the volume of air involved in the manufacturing process. This property can shape the structure of the final product because the air present in the ice cream can provide light texture and affect some physical properties, such as melting and hardness. Purslane powder fortified ice cream samples in the present study showed lower over-run values (78−81.0%) than control sample over-run was (82.5 %).

The ice-creams containing fiber should melt more slowly than the control (without fiber) ice-creams because the fiber slows the rate of heat transfer through the ice creams Warren, M. M., & Hartel, R. W., 2014. The melting rate (ml/min) of the ice creams is shown in, (Table 5). The ice-creams made with purslane had the slowest melting rate, whereas those made with without purslane had the fastest melting rates. The melting rates slowed with increasing levels of purslane powder (1gm and 2gm).

Table 5: Over-run and Melting rate of ice-creams

Ice-creams samples	Over-run (%)	Melting rate (ml/min.)
Control	82.5 ±0.3	0.64 ±0.3
S_1	81.0 ±0.3	0.63 ±0.3
S_2	79.5 ±0.2	0.62 ±0.2
S_3	78.0 ±0.3	0.61 ±0.2

3.2.1.3 Chemical composition of Ice-creams

On basis of the nutritional aspects and sensory analysis S_2 purslane powder fortified ice-cream was accepted and chemical analysis of this sample was done and compared with control. Based on our preliminary study, S_2 purslane powder fortified ice-creams were no significant difference in moisture, fat, protein and carbohydrate but slightly increases the ash and curde fiber content which adversely affect on structural properties of ice-creams (Table 6) but bioactive compounds are present as it is.

Table 6: Chemical analysis of Ice-creams

Component	Ice-cream sample	
	Control	S_2
Moisture (%)	68.15 ±0.05	67.95 ±0.05
Fat (%)	12.0 ±0.3	12.04 ±0.03
Protein (%)	4.35 ±0.05	4.67 ±0.05
Carbohydrate (%)	15.47 ±0.3	15.64 ±0.30
Ash (%)	0.03 ±0.01	0.364 ±0.01
Crude Fibre (%)	Nil	0.9 ±0.20
Total Phenolic compound (mgGAE/100g)	Nil	179.89±0.03
Antioxidant (%RSA)	Nil	89.21±0.05

3.2.2.1 Utilization of purslane powder in cookies

Cake containing high amount of fat can be readily oxidized during processing and storage, which led to the formation of undesirable volatile compounds. The objective of this study was to investigate the feasibility of fortifying purslane powder as the source of antioxidant and protein, i.e., in cookies for enhancing nutritional value and improving storability of the product. Four different variations in purslane powder (2, 4, 6 and 8gm) were made and analyzed for further study.

3.2.2.1 Chemical analysis of Cookies

On basis of the nutritional aspects and sensory analysis C_3 sample was accepted and chemical analysis of this sample was done and compared with control. Based on our preliminary study, C_3 sample were no significant difference in moisture, fat, and carbohydrate but slightly increases the protein, ash and crude fiber content which adversely affect on structural properties of cookies (Table 7) but bioactive compounds are present.

Table 7: Chemical analysis of Cookies

Parameters	Cookies sample	
	Control	C_3
Moisture (%)	3.35 ±0.18	3.34 ±0.2
Fat (%)	21.40±1.22	21.53 ±1.30
Protein (%)	6.77±0.80	7.75 ±0.90
Ash (%)	1.80±0.02	2.89 ±0.05
Carbohydrate (%)	66.68	65.23
Crude Fiber (%)	2.02±0.60	2.29 ±0.08
Total Phenolic compound (mgGAE/100g)	Nil	174.89±0.30
Antioxidant (%RSA)	Nil	83.41±0.05

3.2.2.2 Sensory evaluation of Cookies

In purslane powder fortified cookies, appearance liking and overall liking among the control, 2, 4, 6 and 8gm (w/w refined wheat flour) prepared samples were not scored differently by the panelists, (Fig 5.). However, C_4 sample received lower score, on taste, flavor, mouth feel, appearance and overall acceptability liking. The all over scores showed that C3 sample was the closest to “just a outright”. Some panelists indicated their appreciation on the nutritional value of C_4 sample.

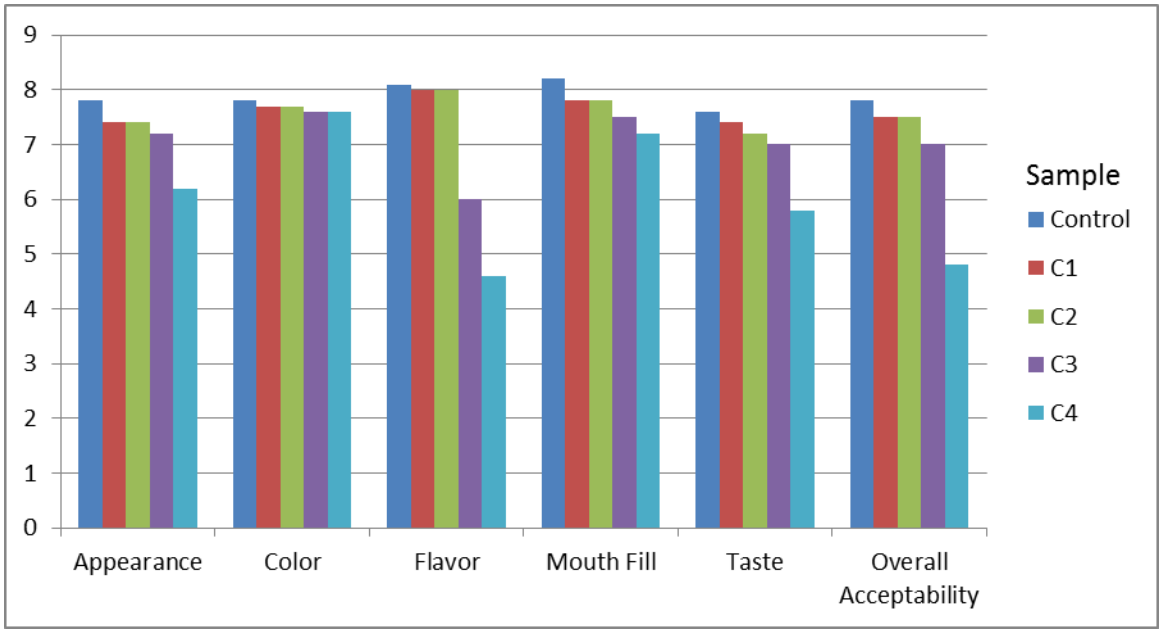

Fig 5: Sensory evaluation of cookies

3.2.2.3 Texture analysis of cookies

Table 8: Hardness of samples

Sample	Hardness (Kg)
Control	4.739 ±0.34
C_3	7.317 ±0.14

4. Conclusion

This study was to make purslane powder as well as to utilize this powder in ice cream and cookies to make them nutrient rich. Drying process for the preparation of purslane powder was optimized. Ice-cream and cookies samples prepared exhibited more suitable nutritional and sensory profile than control sample. The sensory evaluation of ice-cream (S_2) and cookies (C_3) samples established acceptable appearance, taste, texture, and flavor as per panel members. It was observed that prepared ice-cream posses antioxidant (89.21±0.05% RSA), total phenolic content (179.89±0.03mgGAE/100g) and prepared cookies possess antioxidant (83.41±0.05% RSA), total phenolic content (174.89±0.3mgGAE/100g). Thus, it can be concluded from above that prepared ice-cream and cookie samples are nutritious and could be consumed by all age group people. It will also help in improving the health of consumers.

5. References

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