

Nutrient composition, antioxidant activity and phytonutrient of yogurt incorporated with watermelon fruit pulp and its extract

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Abstract

Yogurt is an ancient food that has been a part of the human diet for thousands of years and has been promoted as a healthy diet. Yogurt is milk that has been fermented and is made by adding two specific bacterial cultures to warm milk, namely *Lactobacillus bulgaricus* and *Streptococcus thermophiles*. Yogurt is considered as a cure for diarrhoea, stomach ailments, and irritating skin condition, as well as fungal and yeast infections, and used in some bronchial conditions. High levels of live bacterial cultures in Yogurt contribute to its nutritional and therapeutic properties. The use of different fruits and additives in fruit Yogurt production has improved its nutritional and sensory properties. *Citrullus lanatus* (Watermelon) is a tropical fruit that contains a variety of nutrients, including fibre, vitamins-A, vitamin B1 and B6, potassium, iodine, magnesium, zinc, and antioxidants which are essential for human health. The addition of watermelon in any commercial product enhances the taste, flavour, and nutrient quality. The objective of the study are: To develop Yogurt incorporated with watermelon fruit pulp and its extract; To perform sensory analysis of Yogurt incorporated with watermelon fruit pulp and its extract; To analyse the nutrient composition, phytonutrient composition and antioxidant activity of the Yogurt incorporated with watermelon fruit pulp and its extract; To calculate cost of the developed Yogurt incorporated watermelon fruit pulp and its extract. The developed watermelon fruit pulp and its extract incorporated yogurt were subjected to sensory evaluation for the overall acceptability with the help of a 5-point hedonic scale with 10 semi-trained members. Which was very well accepted. The nutritional analysis was carried out for protein, fat, iron, calcium, and vitamin C content and was found to be high in watermelon pulp and extract incorporated Yogurt. Thus, watermelon fruit pulp and extract incorporated Yogurt has the potential to be used as a dietary supplement to prevent and control the onset of the degenerative disease among the population.

Keywords: Watermelon, *Citrullus lanatus*, Yogurt, Degenerative disease.

1.Introduction

Yogurt is a popular food, and fortification could be an excellent way to introduce nutritional and bioactive components into the human diet (Gahruie *et al.*, 2015). The production of fermented milk (Yogurt) was started in the Middle East and developed all over the world (Goldar *et al.*, 2016). Yogurt is a nutrient-dense food because of its nutritional profile, and it is a rich source of calcium, providing considerable amounts of calcium in bio-available form. It also contains milk proteins with a higher biological value, as well as nearly all of the

essential amino acids required for optimal health. Yogurt consumption also benefits bone health, lowers the risk of chronic diseases, and promotes a healthy life cycle by enhancing food quality (Shiby & Mishra, 2013).

Yogurt consumption directly influences satiety and energy partitioning, which reduces adiposity and is thought to be a significant modulator of insulin resistance. Yogurt also has an impact on insulin sensitivity and pancreatic secretion (Salas-Salvado *et al.*, 2017).

Yogurt is more easily digested, more nutritious, and is an excellent source of carbohydrate, protein, phosphorus, riboflavin (B2), thiamine (B1), vitamin (B12), folate (B9), niacin (B3), magnesium and zinc (Gahruie *et al.*, 2015). *Citrullus lanatus* watermelon fruit is mainly rich in carotenoids and contains up to 92.0% water (Ilahy *et al.*, 2019).

Watermelon is also the richest food source of L-citrulline, a non-essential amino acid that acts as a precursor for synthesizing nitric oxide. Human consumption of watermelon has been linked to lower blood pressure (Figuerola *et al.*, 2017), and watermelon consumption helps improve blood lipid profile in humans (Hong *et al.*, 2018).

2. Methodology

2.1 Selection and Collection of Ingredients

The ingredients used to develop Yogurt incorporated with watermelon fruit pulp and extract were fresh full cream milk procured from Aavin (Tamil Nadu Dairy Farm) outlet available at The Gandhigram Rural Institute Campus. The yogurt preparation culture (*Lactobacillus bulgaricus*) was procured from Vasantham Dairy Farm, Karur. Watermelon fruit was purchased from the local market, Madurai.

2.2 Standardisation and development of Standard Yogurt, Fruit Pulp, and its Extract Incorporated Yogurt

Development of Standard Yogurt: Yogurt is a coagulated milk product obtained from the lactic acid fermentation by the action of *Lactobacillus bulgaricus* and *Streptococcus thermophiles*. In general, Yogurt is made with various ingredients, including milk, stabilizer, flavours, and bacterial culture (*Lactobacillus bulgaricus*). These organisms interact with the milk during fermentation and converts it into Yogurt (Thumrongchote, 2014).

Figure –2.1 Preparation of standard yogurt

Boiled the milk at 85°C for 10 min and cooled at room temperature for 15 mins



Mixed 2mg of *Lactobacillus bulgaricus* culture to 10ml of milk and added to boiled (90ml) & cooled milk



Incubated the mixture at 37° c for 5 hours and then placed in refrigerator for 2 hours

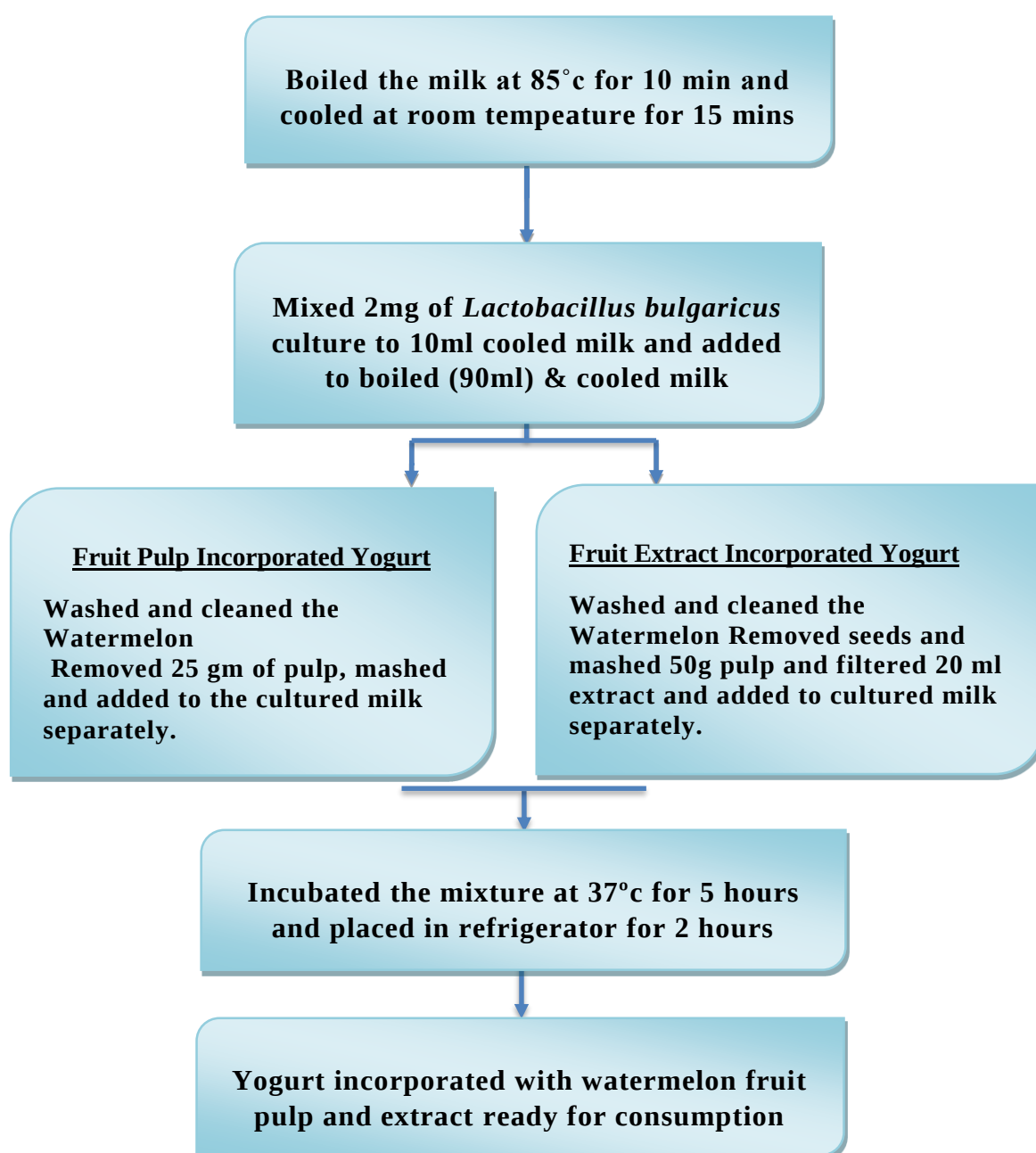


Yogurt was ready for consumption

Development of Yogurt Incorporated with Watermelon Fruit Pulp and its Extract:

Fresh full cream milk from the shop was purchased and heated up to boiling temperature 85°C and cooled to 42°C at room temperature for 15 minutes. To 10 ml of cooled milk, 2 mg of Yogurt culture (*Lactobacillus bulgaricus*) was mixed thoroughly and added to 90 ml of boiled, cooled milk. Fruit pulp 25 gm and 20 ml of extract from 50 gm of watermelon fruit was added to the 10ml of cultured milk individually, incubated at 37°C for 5 hours, and kept in refrigeration for 2 hours. The standard Yogurt and Yogurt developed by incorporating watermelon fruit pulp and its extract with various proportions were standardized by repeating it three to four times to get the correct yield. The procedure followed for the preparation of Yogurt incorporated with watermelon fruit pulp and its extract is given in Figure 2.2.

Figure 2.2 Preparation of yogurt incorporated with watermelon fruit pulp and extract



The watermelon fruit pulp and its extract incorporated in the development of value-added Yogurt is given in Table 2.1

Table 2.1 Development of watermelon fruit pulp and its extract incorporated Yogurt

Fruits Incorporated in Yogurt	Variations		Proportions of Ingredients Used		
			Milk (ml)	Fruit Pulp (mg)	Fruit Extract (ml)
Watermelon	Pulp	WMP ₁	80	20	-
		WMP ₂	75	25	-
	Extract	WME ₁	80	-	20
		WME ₂	75	-	25

Plate 2.1 Steps in development of the watermelon fruit pulp & its extract incorporated Yogurt



2.3 Sensory Evaluation of Standard and Watermelon Fruit Pulp and its Extract Incorporated Yogurt

Sensory profiling is a descriptive method that qualifies and quantifies products' organoleptic properties. In other words, sensory characterization of a food product begins with a descriptive sensory evaluation that provides a pre-defining terminology for describing sensory perceptions as objectively as possible. The terminology is, simply, a set of labels (descriptors) that a panel has agreed upon that enables them to fully describe the sensory properties of the products being evaluated (De-Heer, 2011). Sensory evaluation is carried out by using 5-point hedonic scale with 10 semi-trained members.

2.4 Nutrient Composition, Phytonutrient composition, and Antioxidant activity of Standard and Watermelon Fruit Pulp and its Extract Incorporated Yogurt

Nutrient Composition: The prepared watermelon incorporated Yogurt was subjected to estimation of nutrients, namely, fat, protein, calcium, iron, and vitamin C, using standard procedure.

Phytonutrient composition: Phytochemicals are the chemicals that are present naturally in plants, fruits, and vegetables. These phytochemicals have become more popular due to their countless medicinal uses. Phytochemicals play a vital role against a number of diseases such as asthma, arthritis, cancer, etc (Kayalvizhi *et al.*, 2015). Qualitative analysis of phytonutrients was carried out using the standard procedures.

Antioxidant Activity: Biological antioxidants are substances that are low concentration and can delay or prevent oxidative damage of various biomolecules connected with various diseases. The samples were analysed by using (DPPH) method.

2.5 Cost calculation

The cost of the standard and developed watermelon fruit pulp and Extract incorporated in Yogurt was calculated taking into account ingredients used, processing, and other charges and compared with the commercially available Yogurt.

RESULTS AND DISCUSSION

3.1 Development of Watermelon Fruit Pulp and its Extract Incorporated Yogurt

Watermelon fruit pulp and its extract incorporated Yogurt was made with different variations (WMP1, WMP2, WME1, WME2) developed and standardised.

3.2 Sensory Evaluation of Watermelon Fruit Pulp and its Extract Incorporated Yogurt

The results for the sensory evaluation of the developed product are given in Table 3.1

Table 3.1 Sensory evaluation of watermelon fruit pulp and its extract incorporated Yogurt

Yogurt Incorporated with Fruits	Variations	MEAN VALUE					
		Colour	Texture	Flavour	Appearance	Taste	Overall Acceptability
Standard Yogurt	SY	3.97±0.62	3.64±0.96	3.04±0.85	3.12±0.86	3.53±0.34	3.75±0.19
Watermelon	WMP ₁	3.68±0.62	4.12±0.52	3.88±0.60	3.88±0.52	3.76±0.43	4.08±0.57
	WMP ₂	2.13±0.65	2.98±0.98	2.40±0.24	2.46±0.25	2.75±0.72	2.65±0.63
	WME ₁	4.12±0.83	4.04±0.67	4.24±0.72	4.08±0.40	4.00±0.57	4.36±0.63
	WME ₂	2.43±0.70	2.97±0.96	2.07±0.24	2.75±0.73	2.34±0.38	2.74±0.98

Table 3.1 shows the overall acceptability of the developed watermelon fruit pulp and extract incorporated Yogurt. It was noted that the mean value of overall acceptability of the developed watermelon fruit pulp and extract incorporated Yogurt WMP₁, WMP₂, WME₁, and WME₂ are 4.08±0.57, 2.65±0.63, 4.36±0.63, 2.74±0.98 respectively.

The watermelon fruit pulp and its extract incorporated in (80:20) same proportion shows high acceptability.

3.3 Nutrient Composition of Yogurt Incorporated with Watermelon Fruit Pulp and its Extract

The nutrients such as protein, fat, iron, calcium, and vitamin C of standardized watermelon fruit pulp and its extract incorporated Yogurt. Which has good acceptability (WMP₁ and WME₁) were analysed, and the result is presented in Table 3.2.

Table 3.2 Nutrient composition of yogurt incorporated with water melon fruit pulp and its extract

Yogurt incorporated with fruits	Variations	Nutrients / 100g				
		Fat (%)	Protein (g)	Calcium (mg)	Iron (mg)	Vit- C (mg)
Standard Yogurt	SY	4.5	5.0	122	20	0.9
Watermelon	WMP ₁	4.3	5.3	128	18	0.4
	WME ₁	4.3	5.0	123	15	0.1

From Table 3.2 Shows the nutrient composition of standard Yogurt and watermelon Yogurt incorporated with watermelon pulp and its extract. The watermelon fruit pulp incorporated Yogurt showed good nutrient content of protein (5.3g), calcium (128μ), Iron (18mg), and vitamin-C (0.4mg). Watermelon fruit pulp incorporated Yogurt was good in its nutrient content.

3.4 Phytonutrient Composition, Antioxidant Activity of Yogurt Incorporated with Watermelon Fruit Pulp and its Extract

Qualitative analysis of phytonutrients was carried out with Yogurt developed with watermelon fruit pulp and its extract. The phytonutrient composition in Table 3.3. reveals the Phytonutrient composition of the standard Yogurt, watermelon pulp, and its extract incorporated Yogurt.

When compared to standard Yogurt, watermelon fruit pulp and its extract incorporated Yogurt showed the presence of flavonoids, alkaloids, tannin, and terpenoids.

Yogurt developed from watermelon fruit pulp and its extract have shown the presence of phytonutrients than the standard Yogurt.

Table 3.3 Qualitative phytonutrient analysis of yogurt incorporated with watermelon fruit pulp and its extract

Yogurt incorporated with fruit	Variations	Flavonoids	Alkaloids	Steroids	Saponins	Tannins	Anthroquinone	Phlobatannins	Terpenoids	Glycosides	Cardiac Glycosides
Standard Yogurt	SY	-	-	-	-	-	-	-	-	-	-
Watermelon	WMP ₁	+	+	-	-	+	-	-	+	-	-
	WME ₁	+	+	-	-	+	-	-	+	-	-

+ Indicates Presence – Indicates Absence

Antioxidant Activity of Yogurt incorporated with Watermelon Fruit Pulp and its Extract:

The antiradical activities of Yogurt incorporated with watermelon fruit pulp and its Extract were assessed using DPPH (1, 2 – Diphenyl -2- Picrylhydrazyl) radical scavenging assay. The results of the antioxidant activity of Yogurt incorporated with watermelon fruit pulp and its extract are presented in Table 3.4

Table 3.4 Antioxidant activity of yogurt incorporated with watermelon fruit pulp and its extract

Yogurt incorporated with fruit	Variations	Concentration	Antioxidant Inhibition Activity (%)
Watermelon	WMP ₁	0.1	85.0
		0.2	87.2
		0.3	88.5
		0.4	91.9
		0.5	93.5
	WME ₁	0.1	70.8
		0.2	85.3
		0.3	89.0
		0.4	91.2
		0.5	92.0

Table 3.4 shows that watermelon fruit pulp incorporated Yogurt with 0.5 concentration has high antioxidant inhibition activity of 93.5 %.

3.5 Cost calculation for the developed Yogurt Incorporated with Watermelon Fruit Pulp and its Extract

The cost of 100ml of developed Yogurt incorporated with watermelon fruit pulp and its extract is presented in Table 3.5.

Table 3.5 Cost calculation for the developed yogurt incorporated with watermelon fruit pulp and its extract

Yogurt incorporated with Watermelon	Variations	Ingredients	Quantity	Total cost In Rs
Watermelon	WMP ₁	Milk	80 ml	Rs. 3
		Culture medium	1 g	Rs. 2.5
		Water melon pulp	25 g	Rs. 2
		Packaging and Labelling		Rs. 5
		Overhead charges		Rs. 5
				Rs. 17.5
	WME ₁	Milk	80 ml	Rs. 3
		Culture medium	1 g	Rs. 2.5
		Water melon extract	25 ml	Rs. 2.5
		Packaging and Labelling		Rs. 5
		Overhead charges		Rs. 5
				Rs 18

The cost of the watermelon fruit pulp and its extract incorporated 100ml Yogurt was Rs.18. It is more cost-effective than the commercially available fruit Yogurt.

CONCLUSION

Its be concluded from the study that Yogurt incorporated with watermelon fruit pulp and its extract has overall acceptability with the extended quantity of proximate nutrients, phytonutrients, and antioxidant activity. The protein, fat, iron, calcium, and vitamin C content were found to be high in watermelon incorporated fruit pulp yogurt than its extract incorporated Yogurt. Thus, watermelon fruit pulp and extract incorporated Yogurt has the potential to be used as a dietary supplement to prevent and control the onset of degenerative disease among the population.

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