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Physico-chemical Properties of Grape (*Vitis vinifera* L.) Pomace Fortified Drinkable Yoghurt

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A B S T R A C T

The most effective approach for food waste management is the source of minimization and recovery of by-products. The components present in food waste contribute to high level of nutrients, namely proteins, lipids, carbohydrates, fibres, antioxidants, polyphenols etc. The waste obtained during processing of grapes *(Vitis vinifera* L.*)* includes pomace, can be used in foods which are rich in nutritional and functional properties. Therefore utilization of waste from grape processing into preparation of dairy products which is of low cost raw material is presented in this study. This research was conducted to explore the possibility of utilization of grape pomace obtained during grape juice extraction for the preparation of value added dairy product viz. Drinkable yoghurt. The obtained grape pomace was dried using solar drier at 65ºC for 6 hours and made into powder. The drinkable yoghurt was prepared to which the grape pomace powder was added at different levels of treatment (PT_0, $PT_{0.5}$, $PT_{1.0}$ and $PT_{1.5}$). The physiochemical properties of drinkable yoghurt samples include moisture, pH, titratable acidity, total solids, viscosity, fat and total dietary fibre were determined. Based on the physico-chemical results and sensory attributes the suitable treatment was taken for development of drinkable yoghurt.

Introduction

Grape pomace is widely accumulated in production belts especially arising from *Vitis vinifera* L. seeded variety during trimming and grading of bunches for quality assurance. It is estimated that about 20% of grapes are discarded and disposed off with no established waste reutilization in place. Grape pomace comprises of 2-3 seeds with outer pericarp which possess valuable bioactive polyphenols viz., resveratrol, catechin, epicatechin and anthocyanin in that order of occurrence. Therapeutic properties of grape pomace are not unraveled for its reuse in pharmaceutical and nutraceutical industries especially its application in food processing sector.

Globally, India ranks 10th position in the production of grapes. The major grape producing countries are China, France, and Italy. The crop ranks fifth in India on the basis of agricultural productivity. 80% of total production of grapes in India comes from Maharashtra followed by Karnataka and Tamil

Nadu (Ghosh *et al.*, 2017). It is mainly grown for wine making, raisin making and for consumption as a fresh table grapes throughout the world.

In this study, the process of development of food novelties with grape pomace waste, it has been substituted in the form of powder for fortification of drinkable yoghurt. The physico-chemical properties and sensory attributes of drinkable yoghurt were studied.

Materials and Methods

The grape (*Vitis vinifera L.*) cultivar used in this study is Muscat Hamburg (Panneer/ Gulabi) variety, procured from Koyambedu market, Chennai. The selected grapes were washed in potable water to remove soil particles, dirt, etc. to obtain good quality grape pomace.

The grapes were handpicked from the clusters and the stems were removed carefully. The berries were rinsed with distilled water, dried with filter paper, crushed to obtain pomace. The wet grape pomace was dried in a solar drier at 60- 65°C for 6 hours and ground into fine powder using a domestic food processor to obtain homogenized grape pomace powder (GPP).

Fortification of drinkable yogurt with grape pomace powder

Drinkable yoghurt is a network of proteins with interstitial space containing the liquid phase and void spaces in which starter culture (*Streptococcus thermophiles, Lactobacillus delbrueckii spp. Bulgaricus)* is present.

After incubation, the coagulum of stirred yoghurt is fragmented up mechanically before cooling and packaging, thus inducing considerable changes in the rheological properties.

The flow chart for the preparation of Drinkable Yogurt incorporated with grape pomace powder is given in Figure 1 (De, 1980).

Physio-chemical properties of fortified drinkable yoghurt

Moisture content

The moisture content of the milk beverage was determined by the AOAC (2007) method. About 5g of the samples was weighed in to a pre-weighed clean petri dish and was placed in a hot air oven maintained at 105-110°C for 6 hours. After drying the petri dish was cooled in a desiccator and weighed. This was repeated until a constant weight was obtained. Moisture was expressed in percentage.

$$\text{Moisture content (\%)} = \frac{\text{Moisture loss (g)}}{\text{Weight of the sample(g)}} \times 100$$

Titratable acidity

Titratable acidity (TA) of samples was determined by visual titration method (Ranganna, 1986).About 1 g each of sample was mixed with warm water and volume was made up to 10 ml in 100 ml conical flask. The flask was shaken vigorously and filtered. The filtrates were titrated against 0.1 N NaOH using phenolphthalein as an indicator. Per cent acidity was calculated using the following expression.

$$\text{Titratable acidity (\% of lactic acid)} = \frac{0.0090 \times \text{Volume of NaOH used}}{\text{Weight of the sample}} \times 100$$

pH

A pH meter is an electronic instrument used for measuring the pH (acidity or alkalinity) of a liquid (through special probes are sometimes used to measure the pH of semi-solid substances). A typical pH meter consists of a

special measuring probe (a glass electrode) connected to an electronic meter that measures and displays the pH reading. The pH meter was calibrated with commercial buffer solutions at pH 9.1 and 4.0 before measurement. About 10 ml sample was inserted with a pH electrode and pH was recorded after stabilization.

Total solids

The total solid content (%) of the milk beverage was calculated by using the formula:

Total Solids (%)=100-Moisture Content

Viscosity

Viscosity of the milk beverage was measured with a Rotational Viscometer (Cole-Parmer, India) using Spindle #3.

Fat

The fat content of grape pomace fortified drinkable yoghurt were determined by solvent extraction method using Soxplus apparatus and hexane is used as a solvent (AOAC, 1990).

Total dietary fibre

Total Dietary fibre (DF), including soluble (SDF) and insoluble dietary fibre (IDF) fractions, was analysed by the enzymatic–gravimetric method (AOAC 991.43).

Sensory evaluation

Sensory evaluation of prepared milk beverage using 9- point Hedonic scale (Larmond, 1977) was carried out by panel of judges comprising of six members. All the samples were appropriately coded before subjected to sensory evaluation.

Statistical analysis

The data obtained in all the experiments were analyzed statistically by applying one way ANOVA in IBM SPSS® software (version 20.0) for windows as per the standard procedure of Snedecor and Cochran, 1994.

Results and Discussion

Fortification of drinkable yoghurt with grape pomace variants

Grape pomace powder (GPP) was included at different levels (0.5, 1.0 and 1.5 per cent) in drinkable yoghurt. PT_0drinkable yoghurt was used as control in comparison with grape pomace fortified drinkable yoghurt. Different physicochemical properties were analysed and based on sensory analysis using 9 - point hedonic scale, 1.0 percent of grape pomace powder fortified drinkable yoghurt were exhibited higher level of consumer acceptance.

Physio-chemical properties of fortified drinkable yoghurt

Physio-chemical properties of fortified drinkable yoghurt were highly significant ($p < 0.05$) among treatments that are presented in Table 1.

Moisture content

Grape pomace variant fortified yoghurts had the low moisture values compared to the control yoghurt. This was dependent on the proportion of milk to grape pomace used. The moisture content of the yoghurt samples fell within the range of most commercial yoghurts (80-87 per cent). The results of the present study were in agreement with Maurya (2016) who examined moisture content of guava seed powder fortified yoghurt.

Table.1 Evaluation of physico-chemical properties of drinkable yoghurt fortified with grape pomace powder

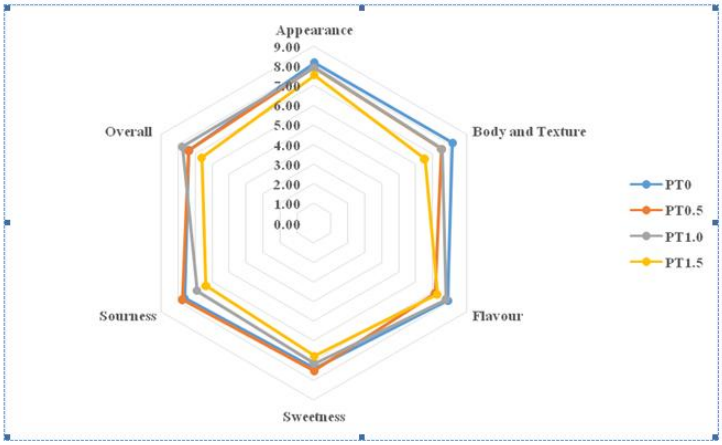
Drinkable Yoghurt	Grape pomace powder (GPP)				
	PT_0	$PT_{0.5}$	$PT_{1.0}$	$PT_{1.5}$	F value
Moisture Content	86.50^{c}±0.00	86.30^{bc}±0.07	86.10^{ab}±0.07	85.99^{a}±0.02	19.141**
Titratable acidity (%)	0.812^{a}±0.00	0.834^{b}±0.00	0.845^{c}±0.00	0.856^{d}±0.00	199.76**
pH	4.37^{c}±0.00	4.36^{c}±0.01	4.34^{b}±0.01	4.32^{a}±0.01	14.75**
Total solids (%)	13.5^{a}±0.00	13.7^{b}±0.07	13.9^{c}±0.07	14.01^{c}±0.02	19.14**
Viscosity (cP)	190.00^{a}±0.15	416.00^{b}±0.07	440.00^{c}±0.47	460.00^{d}±0.17	221247.664**
Fat (g)	3.07^{a}±0.08	3.69^{b}±0.14	3.81^{c}±0.014	4.01^{d}±0.016	8.861**
Total dietary fibre (%)	0.00^{a}±0.00	0.55^{b}±0.00	1.01^{c}±0.00	1.55^{d}±0.00	43569.167**

Average @ 6 trails. ** Highly significant (P < 0.01) difference, * Significant (P < 0.05) difference, NS- No Significant (≥0.05), Different upper case superscripts in a same column differ significantly P ≤ 0.01, PT_0 –control, P-Powder, T-treatments

Fig.1 Flow chart for the preparation of drinkable yogurt

Toned milk
(3% Fat and 8.5% S.N.F)
Addition of skim milk powder (4%)
↓
Addition of sugar (5%)
Filtration/Clarification (35-40°C)
Pre-heating the mix (60°C)
Homogenization (2500 psi)
Pasteurization (85°C/30 min)
Cooling (43-44°C)
Inoculation (2%)
Incubation (41-42°C/3 hour) (0.75% T.A.)
Cooling
Addition of Grape pomace powder(0.5, 1.0 and 1.5%)
Blending
Cooling and storage (5-7°C)

Fig.2 Sensory profile of the grape pomace fortified drinkable yoghurt



Titratable acidity

The titratable acidity of the fortified drinkable yoghurt with grape pomace variants at different inclusion levels increased as the concentration of treatments increased. This may be due to fermentation process of carbohydrate inside the milk (lactose) by lactic acid bacteria to produce lactic acid. Increase in titratable acidity is trailed by decrease in pH. This was in accordance with Agustini *et al*. (2017) who enriched yoghurt with *Spirulina platensis* powder.

pH

In this study, it was found that pH of the fortified drinkable yoghurt with grape pomace variants at different inclusion levels decreased as the concentration of treatments increased, because the pH value of pomace grape flour was 3.82 (Sousa *et al.* 2014). Similar results were found when fortifying drinking yogurt with dried apple peel powder Zhou, Z. (2018).

Total solids

Total solids content of drinkable yoghurt fortified with grape pomace powder increased as the treatment concentration increases whereas no significant change was observed in drinkable yoghurt fortified with ethanol and aqueous grape pomace extract. This is due to higher content of total solids. This was in agreement with the results published for yoghurt enriched with grape juice (Hossain *et al.*2012) and pineapple juice Gangwar *et al.* (2016).

Viscosity

Viscosity of grape pomace variants enriched drinkable yoghurt increased as the concentration increases; this might be due to the fact that the total dietary fiber content of grape pomace is higher. Similar study has been carried out for drinking yoghurt enriched with dried apple peel powder (Zhou, 2018).

Fat

In this study, it was found that fat content of the fortified drinkable yoghurt with grape pomace variants at different inclusion levels increased as the concentration of treatments increased, due to high fat content in pomace grape flour (Sousa *et al.* 2014). Similar results were reported by Maurya (2016) who examined fat content of guava seed powder fortified yoghurt.

Total dietary fibre

In this study, it was found that total dietary fibre content of the fortified drinkable yoghurt with grape pomace variants at different inclusion levels increased as the concentration of treatments increased, due to high total dietary fibre content in pomace grape flour (Sousa *et al.*, 2014). The present study was found complementary to the report of Mohamed *et al.,* (2014) who reported similar trend in yoghurt fortified with dietary fibre and phenolic compounds.

Sensory evaluation

In grape pomace powder fortified drinkable yoghurt, sensory attributes such as appearance, body and texture, flavor, sweetness, sourness and overall acceptability among the control, 0.5, 1.0 and 1.5 per cent scores reduced as the concentration of grape pomace powder increases. The scores for sensory attributes of 1.0% grape pomace powder fortified drinkable yoghurt were found to have scored the highest among the different treatments as shown in Figure 2. Some panelists indicated their appreciation on the nutritional value and fruity taste of grape pomace powder fortified yogurt, but others stated their disliking on the chalky and medicinal after taste which might come from the astringency of tannin in grape pomace.

The results were in conformity with studies by Tseng and Zhao, (2012) who studied Wine grape pomace as antioxidant dietary fibre for enhancing nutritional value and improving storability of yogurt and salad dressing.

Hence concluded in this study, grape pomace powder fortified drinkable yoghurt with 1.0% level was accepted by the panelists. Dairy products are deficient in Dietary fiber, addition of grape pomace powder enriched dietary fiber content could be potentially considered as a source of ingredient for drinkable yoghurt supplementation. Thus the by-product obtained from grape juice could be utilized as a raw material for the preparation of drinkable yoghurt.

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