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Formulation of Nutraceutical Enriched Fruits and Nuts Spread

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The growing trend of healthy and nutritious food eating among consumer is expected to be a major driver for the growth of global fruits spreads market. There is an increasing demand for food products, incorporated with fruits, vegetables and nuts with no or less preservatives. The innovations in improving the flavor and nutritional value of fruits spreads are expected to boost the growth of global fruits products markets. The hard coating nature of the pumpkin and cucumber seeds made it underutilized. Keeping this in view, the present study was formulated to produce nutraceutical enriched fruits and nuts spread. The pumpkin and cucumber seed powders were blended with fruits like mango, papaya and muskmelon. The seeds are rich in nutraceutical compounds such as β carotene, tannin, flavonoids, polyphenols and antioxidant properties. The 25% of pumpkin seeds are incorporated with 75% of each fruits and 25% of cucumber seeds are incorporated with 75% of each fruits. Based on the organoleptic evaluation, the fruit spread made

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with seeds and mango pulp was highly acceptable. The proximate values of pumpkin seeds incorporated mango spread had 33.34% moisture, 23.62 g protein, 26.73 g fat, 5.21 g fiber and 24.32 g of carbohydrate. The mango and cucumber seeds had 33.70% moisture, 15.21 g protein, 29.18 g fat, 6.82 g fiber and 21.46 g carbohydrate.

Keywords: Fruits spread; pumpkin seed; cucumber seeds.

1. INTRODUCTION

Fruit spreads contain mixtures of fruit and concentrated fruit juices and can have as little as 30% real fruit or as much as 60% [1,2]. Due to the presence of pectin, fruit spreads have most of the health benefits such as cardio productive, anti-proliferative; antioxidant power which is also increasing the demand for fruit spreads. Product development and analysis of nutraceutical compounds such as β-carotene, tannin, flavonoids and polyphenols in enhanced fruits and nuts spreads [3].

Pumpkin belongs to the genus *Cucurbita* and family *Cucurbitaceae*. The seed content of pumpkin fruit varies from 3.52% to 4.27% [4,5]. Pumpkin seeds are gaining attention towards the snack food industry as a healthy alternative to other fried snacks [6]. The nutraceutical and health benefits of pumpkin seeds are ant diabetic, antibacterial, antifungal and antioxidant activities. They play major role in reducing/ lowering blood pressure and provides high density lipoprotein cholesterol synthesis [7]. The pumpkin seed as dietary supplement has exposed the same effects to the calcium channel blocker as a drug amlodipine [8].

Cucumber (*Cucumis sativus* L.), belongs to family *Cucurbitaceae*. The seeds of cucumber have been widely used in China as a health food and medicine source [9]. Cucumber seeds have a significant positive impact in diseases such as osteoporosis and osteoarthritis [10]. The peel and seeds are the most nutrient-dense parts of the cucumber. The cucumber seeds contain fiber, minerals, β -carotene and calcium [11].

The global production of mango was 46.5 million tons in 2016 and approximately 13.5% [12]. The pulp was marketed minimally processed or industrialized as juices or canned products. Mango contains 15% carbohydrates, 1.6% dietary fiber, 0.38% fat and 0.82% protein, vitamins A, C, β-carotene and Phenolic antioxidants [13]. Papaya (*Carica papaya* L.) belongs to the family of *Caricaceae*. It contain rich source of Iron, Calcium, Vitamin A, B, C. Melon fruit belongs to the family *Cucurbitaceae* [14]. Muskmelon fruit contain phenolic Phytochemicals, other essential nutrients and preserving its pulp may meet the demand of market throughout the year [15,16].

1.1 Statistical Analysis

The data were obtained to subject to find out the physical, chemical and phytochemical properties of the fruits and nuts spreads. AGRES statistical software was applied to find the mean values.

2. MATERIALS AND METHODS

The pumpkin, cucumber seeds including fruits like mango, papaya and muskmelon were purchased from local market of Madurai, Tamil Nadu, India. The seeds were dehulled and roasted at the temperature of 150°C for 30 mins to remove the hard coating and to mask the raw odour of the seed.

2.1 Formulation of Fruits and Nuts Spread

The fruit pulps were extracted from mango, papaya and muskmelon and produced fruitpulps. The roasted seed were milled into flour. The standardized compositions of seed powders (25%) were mixed with 75% of fruit pulp to get a desirable consistency of fruits and nuts spread. Sugar was added to fruits and Nuts spread at 5°brix. The fruits and nuts spreads were pasteurized at 60°C for 30mins to increase the quality of the product and the prepared products were organoleptically evaluated by using 9 point Hedonic scale. They were kept at refrigerated temperature for further analysis. The microbial content such as total plate count, yeast and mold were analyzed [17].

Table 1. Combination of fruits and nuts spread

Treatment	Fruits (75%) + seed powder (25%)
T_1	Mango + pumpkin seed powder
T_2	Papaya + pumpkin seed powder
T_3	Muskmelon + pumpkin seed powder
T_4	Mango + cucumber seed powder
T_5	Papaya + cucumber seed powder
T_6	Muskmelon + cucumber seed powder

2.2 Proximate Composition

Table 2. List of parameters used with standard method

S. no	Parameters	Methods
1.	Moisture	AOAC (1997)
2.	Protein	Micro kjeldhal (Ma and Zuazaga,1942)
3.	Fat	Sox plus apparatus (Cohen,1917)
4.	Fiber	Maynard (1976)
5.	Carbohydrate	Anthrone method (Sadasivam and Manickam,2008)
6.	Phytochemicals (β -Carotene, tannin, Flavanoids and Polyphenols)	Sadasivam (2008)
7.	Antioxidant activity	DPPH assay (Mandey,2019)
8.	Viscosity	Brooke field viscometer
9.	Acidity	Titrable acidity (Rangenna,2001)

3. RESULTS AND DISCUSSION

3.1 Sensory Evaluation

The sensory evaluation was done in the fruits and nuts spreads by using 9 point hedonic scale.

Based on the sensory evaluation T1 (mango+ pumpkin seed powder) combination was highly acceptable when compared to other combinations of fruits and nuts spreads.

3.2 Effects of Different Treatment on Physical Property

Table 3. shows the moisture content of fruits and nuts spread lies in the range of 32.23% - 33.45%.T_3 (Muskmelon + Pumpkin seed powder) had more amount of moisture content compared with other treatments. The shelf life of spreads T_3 is low due to the high moisture content. Malkanthi et al. [18] reported that the pumpkin seed powder blended biscuits had moisture of 3.23% and the reason of this the biscuits were baked at 160℃ for 15 min. Mishra et al. [19] reported that the pumpkin seed incorporated value added products contain 4.47% of moisture. The acidity of fruits and nuts spreads range between 3.64–6.64%. T_3 (Muskmelon + Pumpkin seed powder) and T_6 (Muskmelon + Cucumber seed powder) Contain less of acidity due to the muskmelon pH content and T_1 and T_4 contain higher that amount of acidity due to the acidic nature of mango fruits. Aruna et al. [20] reported that the muskmelon jam contain 0.42% of acidity. The viscosity of fruits and nuts spreads range from 3.21 to 5.42 centipoises (cP).

3.3 Effects of Different Treatment on Carbohydrate and Protein

Table 4. shows the protein content of fruits and nuts spread were decreased from 23.62 g (T_5 – Papaya + Cucumber seed powder) to 13.81 g (T_6-Muskmelon + Cucumber seed powder).The protein content of T_1 (Mango + Pumpkin seed powder) is slightly higher than the after treatments of spreads. Carbohydrate content in the treatments like T_2,T_3,T_4 and T_5 of fruits and nuts spread were ranged between.19.48 to 27.81 g whereas the treatment T_6 (Muskmelon + Cucumber seed powder) the carbohydrate content is 19.48 g. Malkanthi et al. reported that the pumpkin seed powder blended biscuits 13.89 g of protein. Mishra et al. showed that the pumpkin seed incorporated value added products contain 20.15 g of protein. The carbohydrate content of fruits and nuts spreads range between 19.48 -27.81 g. T_6 (Muskmelon + Cucumber seed powder) contain limited amount

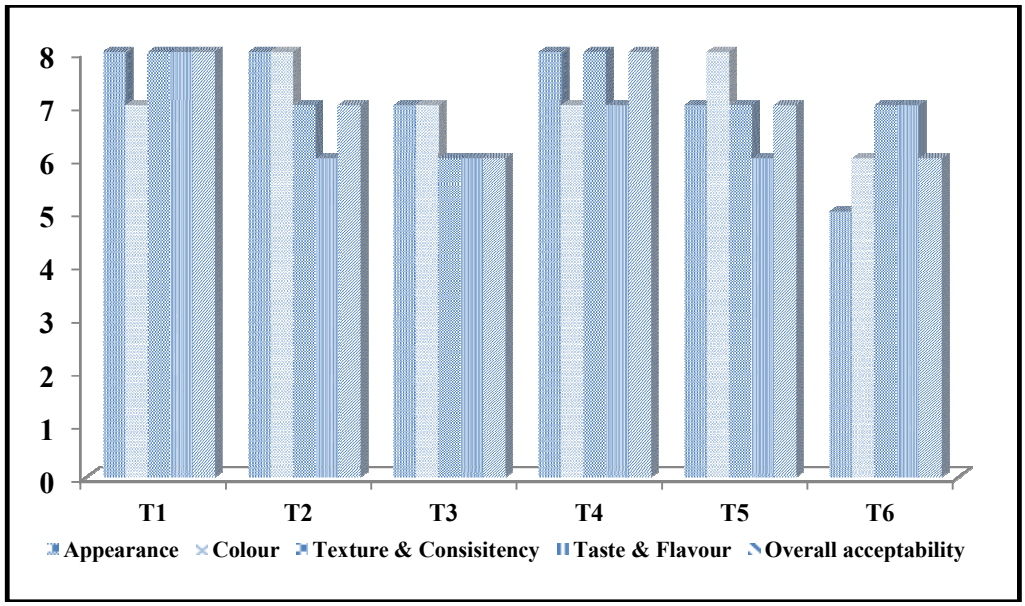

Fig. 1. Sensory characteristics of fruits and nuts spread. The data points are the mean ±SD from four replicates

Table 3. Proximate composition and physical properties of fruits and nuts spreads

Treatments	Moisture (%)	Acidity (%)	Viscosity(centipoise)
T_1	33.34±0.19^{de}	3.41± 0.07^{e}	5.42±0.05^{a}
T_2	33.01±0.00^{b}	5.91±0.11^{b}	4.32±0.10^{d}
T_3	33.45±0.15^{e}	6.03±0.14^{b}	3.21±0.06^{f}
T_4	32.70±0.15^{a}	3.64±0.09^{d}	5.01±0.09^{b}
T_5	32.23±0.24^{c}	5.43±0.14^{c}	4.67±0.08^{c}
T_6	33.27±0.80^{cd}	6.64±0.09^{a}	3.53±0.10^{e}

Values are means of 4 replicates. Means in the same column followed by different superscripts are significantly different at P<0.05

Table 4. Nutritional values in fruits and nuts spreads

Treatments	Protein(g)	Fat (g)	Fiber (g)	Carbohydrate (g)
T_1	23.62±0.83^{a}	26.73±0.01^{b}	5.21±0.07^{f}	24.32±0.67^{d}
T_2	19.42±0.54^{c}	33.48±0.41^{e}	6.00±0.06^{e}	27.81±0.90^{e}
T_3	18.02±0.66^{d}	42.01±1.11f	7.38±0.01^{c}	22.05±0.61^{b}
T_4	15.21±0.32^{e}	29.18±0.75^{c}	6.82±0.04^{d}	21.46±0.04^{b}
T_5	22.22±0.50^{b}	23.52±0.49^{a}	8.00±0.17^{a}	23.01±0.57^{c}
T_6	13.81±0.63^{f}	32.37±0.83^{d}	7.55±0.10^{b}	19.48±0.03^{a}

Values are means of 4 replicates. Means in the same column followed by different superscripts are significantly different at P<0.05

of carbohydrate compared to others. Mandey et al. reported that the cucumber seed meal contain only 21.01 % of carbohydrate.

3.4 Effects of Different Treatment on Fat and Fiber

Table 4. shows the fat content of fruits and nuts spread were increased from 23.52 (Papaya + Cucumber seed powder) to 42.01 g (Muskmelon + Pumpkin seed powder). T_5 (Papaya + Cucumber seed powder) contain less amount of fat compared to others. Mandey et al. reported that the cucumber seed meal contain 14.14% of fat. The fiber content of fruits spread was increased from 5.21 to 18 g. When compared to other treatments T_5 (Papaya + Cucumber seed powder) exhibits higher level of fiber content. Mandey et al. evaluated that the cucumber deed meal contain 32.27% of fiber.

Table 5. Phytochemical screening in fruits and nuts spreads

Treatments	β-Carotene (mg)	Tannin (%)	Flavonoids (%)	Poly phenols (%)	Antioxidant activity (RS %)
T_1	7.25±0.05[a]	1.23±0.03[a]	2.17±0.01[b]	5.21±0.07[a]	83.02±1.41[b]
T_2	5.64±0.11[b]	0.84±0.04[b]	3.04±0.02[a]	4.03±0.01[c]	84.74±0.98[a]
T_3	5.04±0.05[c]	0.73±0.01[c]	1.65±0.01[c]	4.98±0.03[b]	80.28±0.87[c]
T_4	1.83±0.08[d]	0.15±0.05[e]	0.25±0.05[d]	0.35±0.09[d]	2.67±0.06[e]
T_5	1.42±0.01[e]	0.02±0.06[f]	0.15±0.06[f]	0.26±0.08[e]	3.52±0.11[e]
T_6	1.05±0.02[f]	0.18±0.08[d]	0.20±0.07[e]	0.19±0.05[f]	4.93±0.02[d]

Values are means of 4 replicates. Means in the same column followed by different superscripts are significantly different at P<0.05

3.5 Effects of Different Treatment on Phytochemicals

Table 5. shows the β- carotene content increased from 1.05 (Muskmelon + Cucumber seed powder) to 7.25 mg (Mango + pumpkin seed powder). T_1 contain maximum amount of β-carotene because the pumpkin seed has rich source of β- carotene.T_6 contain minimum amount of β- carotene because the cucumber had less amount of β- carotene. Malkanthi et al. showed that the pumpkin seed contain 5.67 g of β- carotene. Mandey et al. envisaged that the cucumber seed has only 2.82 mg of β- carotene. The tannin content of fruits and nuts spread ranged between 0.02 to 1.23%.The T_5 contain fewer amount of tannin content because the cumber had less amount of tannin. Mandey et al. contemplated in this research that the cucumber seed contain 0.01% of tannin and inference stated that the flavonoids content gradually decreased from 3.04 to 0.15%. The T_5 contain fewer amounts of flavonoids because the cucumber seed had low source of flavonoids. Mandey et al. determined at the cucumber seed contain 0.365 of flavonoids. The polyphenols are increased from 0.19 to 5.21%.There was a reduced amount of polyphenols upto 0.40% only due to less amount of polyphenolic compounds present in the cucumber seeds. Mandey et al. showed that the cucumber seed had only 0.40% of polyphenols. The antioxidant activity of fruits and nuts spread lies between 2.67 to 34.74 (RS %). T_2 contain higher amount of antioxidant content compared to others.

4. CONCLUSION

Among the six treatments the T1 (mango+ pumpkin seed powder) combinations had more amounts of β-carotene, flavonoids, polyphenols and antioxidant properties because mango and pumpkin seeds were rich source of Phytochemicals when compared to other fruits like papaya and muskmelon and cucumber seeds.

SUMMARY

The pumpkin seeds and cucumber seeds considered as an underutilized seeds but it has enormous nutritional values and also nutraceutical properties. It was used in the spread to increase the nutraceutical value of the spread and it is highly preferred for all age groups and preferred them as best ready to use food. The fruits and nuts spread encompassed of enormous bioactive compounds when compared to other fruits spread available in market.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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