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Abstract

Changing nutritional demands in combination with the global trend for snacking sets a goal for preparing food products for direct consumption with certain beneficial properties. This study was designed in order to investigate the quality characteristics of raw vegan bonbons enriched with lyophilized peach powder. Three types of formulations were prepared where 10, 20, and 30% of lyophilized peach powder was respectively added.

The newly developed vegan products were characterized in terms of their physical (moisture, ash, color, water activity), microbiological, nutritional, and sensory characteristics. Their antioxidant activity and flavonoid, and phenolic content were also evaluated.

Considering the content of the bonbons, health claims can be made – high in fiber, sources of fiber, with no added sugar, contains naturally occurring sugars. The color measurements demonstrated similarity in the values. The sensory characteristics of the products revealed that all formulations were accepted by the panelists. This study showed that there is a significant potential in the production of healthy snacks for direct consumption with beneficial properties.

Keywords: health-enhancing; raw snack; health claims; healthy ingredients

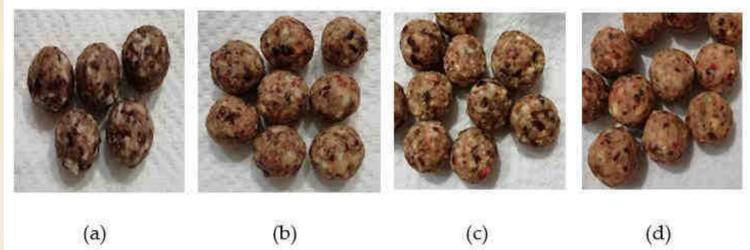


Figure 1. Bonbon formulations. (a) Control sample; (b) LPP10; (c) LPP20; (d) LPP30.



Figure 2. Electronic microscopic photographs of bonbon formulations' surface (160x). (a) Control sample; (b) LPP10; (c) LPP20; (d) LPP30.

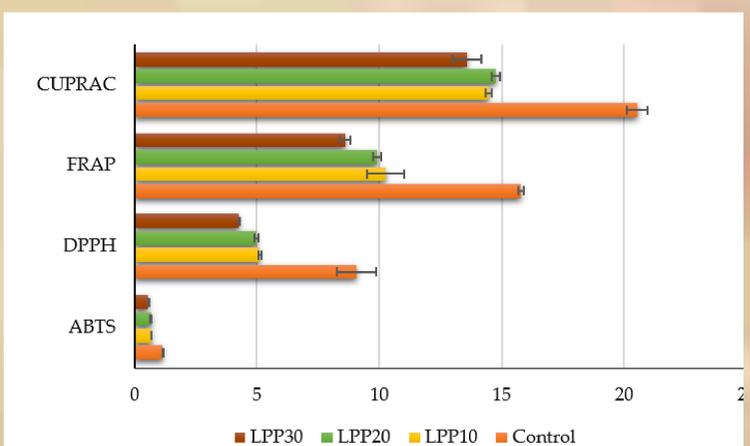


Figure 2. Antioxidant properties of bonbon formulations (ABTS - mM/g dw; DPPH, FRAP, CUPRAC - μM/g dw).

The TPC showed the highest value in the control sample and the lowest value in LPP30. When the TFC is considered, LPP20 is the formulation with the highest values. All formulations containing lyophilized peach powder showed similar AOA results, which may lead to the conclusion that the percentage incorporated does not influence the overall antioxidant activity.

The newly developed bonbon formulations can be used as a quick snack throughout the day or an enrichment to one's daily healthy meal plan.

Table 6. Total flavonoid content (TFC) and total phenolic content (TPC) of bonbon formulations.

Bonbon formulations	Total flavonoid content, μgQE/g fw	Total phenolic content, mgGAE/g dw
Control sample	84,64±1.69 ^c	1,89±0.03 ^a
LPP10	78,13±1.36 ^d	1,33±0.00 ^c
LPP20	117,63±1.37 ^a	1,40±0.04 ^b
LPP30	100,29±2.55 ^b	1,21±0.01 ^d

Different letters in the same column indicate statistically significant differences ($p < 0.05$), according to ANOVA (one-way) and the Tukey test.

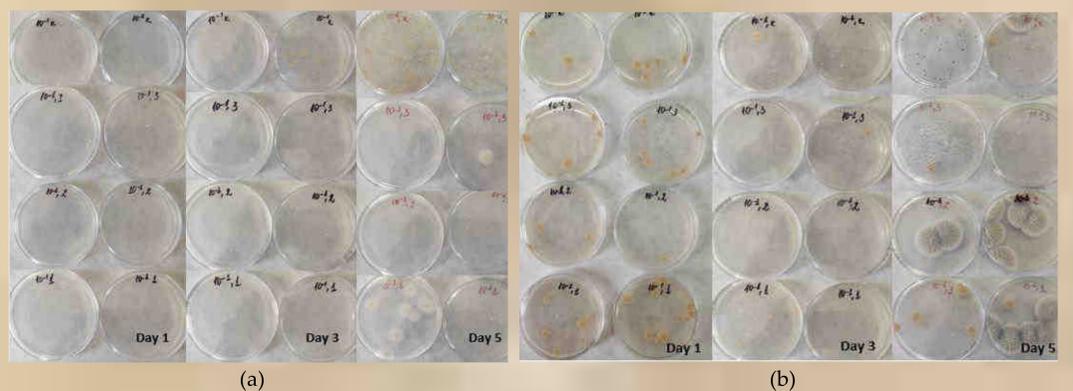


Figure 4. View of microbial growth in bonbon formulations. (a) AMM; (b) YM.

Table 1. Weight (g), size (mm), ash (%) and moisture (%) content of bonbons.

Bonbon formulations	Weight, g	Diameter, mm	Ash content, %	Moisture content, %
Control	8.87±0.60 ^a	25.15±0.39 ^a	1.20±0.31 ^a	7.51±0.03 ^a
LPP10	8.31±0.54 ^a	25.12±0.67 ^a	1.44±0.34 ^a	5.05±0.05 ^d
LPP20	7.92±0.69 ^a	24.61±0.88 ^a	1.41±0.08 ^a	7.07±0.09 ^b
LPP30	7.86±0.79 ^a	24.70±0.80 ^a	1.47±0.00 ^a	6.45±0.06 ^c

Different letters in the same column indicate statistically significant differences ($p < 0.05$), according to ANOVA (one-way) and the Tukey test.

Table 2. Nutritional data of bonbon formulations.

Bonbon formulations, 100g	Proteins, g	Carbohydrates, g	Sugars, g	Fiber, g	Fat, g	Monosaturated fats, g	ω 3, g	Energy, kcal
Control sample	7.77	29.16	25.70	4.96	50.54	18.96	1.73	612.36
LPP10	6.48	25.50	21.89	4.38	48.76	19.80	1.44	574.99
LPP20	5.18	21.87	18.09	3.80	46.98	20.64	1.15	537.63
LPP30	3.89	18.22	14.27	3.22	45.21	21.48	0.86	500.27

Table 4. Water activity (a_w) of bonbon formulations.

Bonbon formulations	water activity a_w	
	Day 1	Day 5
Control sample	0.559±0.007 ^c	0.546±0.06 ^c
LPP10	0.503±0.009 ^b	0.496±0.06 ^b
LPP20	0.492±0.003 ^a	0.482±0.003 ^b
LPP30	0.468±0.013 ^a	0.458±0.013 ^a

Different letters in the same column indicate statistically significant differences ($p < 0.05$), according to ANOVA (one-way) and the Tukey test.

Table 3. Sensory evaluation of bonbon formulations.

Bonbon formulations	Overall preference	Color	Aroma	Taste	Texture
Control sample	4.00±0.77 ^{ab}	4.00±0.77 ^a	4.30±0.64 ^a	4.30±0.71 ^a	4.00±0.77 ^a
LPP10	4.30±0.64 ^a	4.30±0.64 ^a	4.00±0.77 ^a	4.30±0.64 ^a	4.10±0.70 ^a
LPP20	4.30±0.64 ^a	4.30±0.64 ^a	4.35±0.66 ^a	4.35±0.65 ^a	4.00±0.63 ^a
LPP30	3.60±0.66 ^b	4.40±0.66 ^a	4.25±0.69 ^a	4.00±0.77 ^a	3.80±0.60 ^a

Different letters in the same column indicate statistically significant differences ($p < 0.05$), according to ANOVA (one-way) and the Tukey test.

The results of this research reveal the possibility of developing raw vegan bonbons with the addition of lyophilized peach powder. All three formulations were well accepted by panelists. They described the samples as soft and brittle, easy to chew, with a crunchy feeling in the mouth which makes them an easy quick snack part of people's diet.

When it comes to texture, the hardness of the bonbon formulations increased progressively for 5 days of storage. A_w decreased and the microbial load showed that the lyophilized peach powder as an ingredient has favorable influence of the plate count and mold growth.

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