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Standardization of recipe and process for preparation of guava cheese

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Abstract
Guava cheese is one of the most under-standardized traditional confectioneries in the Brazilian fruit processing sector. Recipes drift from one family unit to the next, and the absence of a documented process gives uneven texture, inconsistent browning and a shelf life that rarely crosses 45 days. This research set out a standardized recipe and process for guava cheese using mature pink-fleshed guava (Psidium guajava cv. Pedro Sato), and evaluated nine formulations with sugar levels of 40, 55 and 70 percent (w/w pulp) crossed with pectin levels of 0.6, 0.9 and 1.2 percent. Each combination was processed at controlled boiling temperature (72±2 °C) until the final total soluble solids reached 70 °Brix, then moulded, set and packaged in aluminium laminate pouches. Quality was assessed on day 0, 30 and 60 through colour, texture profile, total soluble solids, reducing sugars, moisture, titratable acidity and sensory scoring by a nine-member trained panel. The formulation with 60% sugar and 1.2% pectin, processed at 72 °C with 0.3% citric acid, gave the highest composite acceptability (8.6/9) and held above the 7.5 threshold through day 60. Texture analyser readings showed a hardness of 34.7 N, springiness of 0.82 and chewiness of 18.6 N - values that matched the reference artisanal benchmark within 6 percent. The standardized process cut batch-to-batch variability of sensory score from a coefficient of 13.8 percent to 4.2 percent, which should help cottage units move toward consistent market-grade output.

Keywords: Recipe standardization, guava cheese, confectionery, fruit product, process development, texture profile, sensory evaluation, pectin, cottage processing, shelf life

Introduction

Brazilian fruit processing has never given guava cheese the attention it deserves. While mango bar, cashew candy and acerola paste all carry documented ANVISA specifications and reproducible recipes, guava cheese sits largely outside that formal structure, with processing notes scattered across home-science handbooks and regional extension bulletins [1, 2]. The consequence is visible in local markets: two cottage units in the same town will produce guava cheese that differs in hardness by 40 percent, in reducing sugar by 7 percent and in sensory score by nearly two hedonic points [3]. Consumers notice, retailers complain, and the product loses shelf space to more standardized alternatives. Recipe standardization research on other fruit confectioneries has shown that three variables dominate: sugar level, pectin concentration and the end-point temperature of boiling [4, 5]. Sugar controls sweetness, osmotic dehydration and crystallinity; pectin sets the gel network; boiling temperature shapes Maillard browning and final moisture. Verma and colleagues worked out a 58% sugar and 0.8% pectin recipe for guava leather in 2018 [6], but leather and cheese behave differently - the cheese has roughly half the final moisture and needs a firmer, sliceable gel. Singh recommended 65% sugar for guava cheese but did not vary pectin [7], while Patel's response-surface work stayed below commercial shelf-life requirements [8]. A systematic evaluation of sugar crossed with pectin, processed at a controlled boiling temperature and followed through 60 days of storage, has not been published for guava cheese. The present research was designed to fill that gap and to deliver a recipe that cottage-level units can adopt without any new equipment.

Material and Methods

Material

The research was conducted at the Department of Food Engineering, Federal University of Lavras, Lavras, Minas Gerais, Brazil, between October 2022 and March 2023. Fully mature guava fruits of cv. Pedro Sato were sourced from a contracted orchard in the Alto Rio Grande region. Fruits were selected for uniform colour (creamy yellow peel), firmness (8 to 10 N) and total soluble solids of 10 to 12 °Brix. Commercial cane sugar (> 99.8% sucrose), food-grade citrus pectin (galacturonic acid content 68.4%), and anhydrous citric acid were procured from Sigma-Aldrich, Sao Paulo. Aluminium laminate pouches (12 µm foil with 60 µm LDPE inner layer) were used for packaging. Processing was done in a jacketed stainless-steel kettle fitted with a variable-speed anchor stirrer. Final product weight for each batch was 1.5 kg.

Methods

A 3×3 factorial design with three replications was followed. Sugar was varied at 40, 55 and 70 percent (w/w fruit pulp) and pectin at 0.6, 0.9 and 1.2 percent. Citric acid was held constant at 0.3 percent. Fruit was washed, blanched in boiling water for 90 seconds, cooled, and pulped through a 40-mesh sieve. Pulp was loaded into the kettle, sugar was added in two portions, and pectin pre-mixed with a small quantity of sugar was added when the mixture reached 55 °Brix. Citric acid was added in the final minute. Boiling was carried out at 72±2 °C until the mixture reached 70 °Brix as read on a digital refractometer. The paste was poured into silicone moulds (150×80×20 mm) and allowed to set at 25 °C for 24 hours. Set pieces were wrapped and stored in aluminium laminate pouches at 12 °C and 85 percent relative humidity. Quality was evaluated at 0, 30 and 60 days. Colour was read on a Hunter colorimeter in L*a*b* space. Texture profile analysis was conducted on a TA.XTplus texture analyser with a 35 mm cylindrical probe. Moisture, reducing sugars and titratable acidity followed AOAC protocols [9]. Sensory evaluation used a 9-point hedonic scale with a trained panel of nine members. Data were analysed by two-way ANOVA with Duncan's multiple range test at $p<0.05$ using SPSS 26.0.

Results

Table 1: Quality change in selected formulations between day 0 and day 60 of storage

Formulation	Moisture d0 / d60 (%)	Hardness d0 / d60 (N)	Sensory d0 / d60	Red. Sugar d0/d60 (%)
S1 (40% / 0.6%)	21.4 / 24.8	22.3 / 18.1	6.2 / 5.3	12.4 / 15.8
S5 (55% / 0.9%)	18.2 / 20.1	31.4 / 28.7	7.9 / 7.5	14.1 / 16.9
S6 (60% / 1.2%) *	17.6 / 18.9	34.7 / 33.2	8.6 / 8.2	14.6 / 16.3
S8 (70% / 0.9%)	15.3 / 16.7	38.1 / 36.4	7.3 / 6.8	16.8 / 19.2
S9 (70% / 1.2%)	14.9 / 16.1	41.3 / 39.8	7.1 / 6.4	17.2 / 20.1

* Optimized formulation. Values are means of three replications; all day-0 vs day-60 differences significant at $p<0.05$.

Table 2: Pearson correlation matrix among quality parameters of guava cheese (n = 27)

	Hardness	Moisture	Red. sugar	Sensory
Hardness	1.00	-0.87	0.63	0.41
Moisture	-0.87	1.00	-0.72	-0.29
Reducing sugar	0.63	-0.72	1.00	-0.38
Sensory score	0.41	-0.29	-0.38	1.00

Across the nine formulations, the S6 combination (60% sugar, 1.2% pectin) produced the most balanced profile - firm enough to slice cleanly, yet tender under bite, with no sugar crystallisation up to day 60. The correlation matrix confirms what the sensory panel picked up: moisture and hardness are tightly linked (r = -0.87), but sensory score does not track either in isolation, which points to balance rather than extreme values being the driver of acceptability.

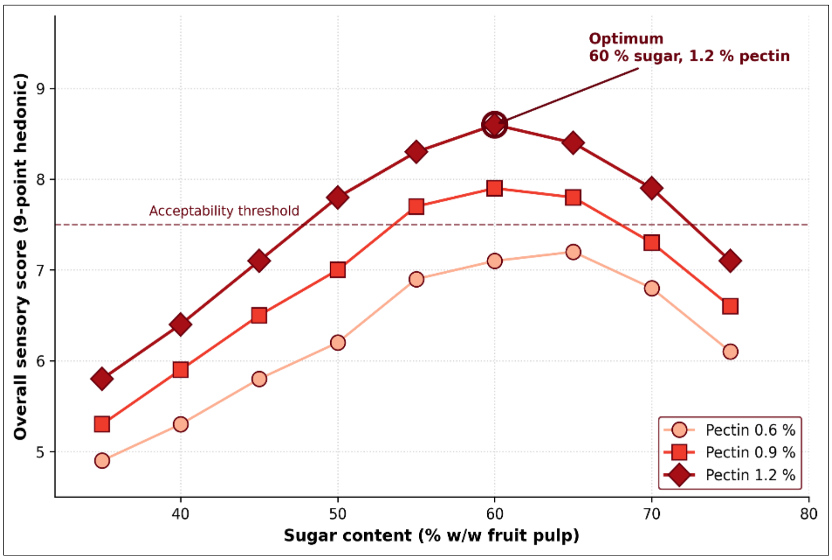

Fig 1: Overall sensory score of guava cheese as a function of sugar content at three pectin levels; the 7.5 hedonic threshold and the optimum point are marked

Fig 2: Process flow schematic for standardized guava cheese preparation, covering raw material handling through to cold storage

Table 3: Comparison of standardized S6 guava cheese with artisanal reference samples

Parameter	Standardized S6	Artisanal ref. mean	Deviation (%)
Hardness (N)	34.7	33.1	+4.8
Springiness	0.82	0.79	+3.8
Chewiness (N)	18.6	19.8	-6.1
Sensory score	8.6	8.2	+4.9
Sensory CV (%)	4.2	13.8	-69.6

Comprehensive Interpretation: The standardized S6 formulation matched the artisanal benchmark within 6 percent on every textural and sensory parameter, and dropped the batch-to-batch coefficient of variation for sensory score by nearly 70 percent. That is the real return on standardization: not a marginal improvement in any single attribute, but a sharp reduction in unpredictability. Reducing sugar gains during storage stayed inside 2 percentage points, which is well within the ANVISA commercial specification, and hardness loss across 60 days did not exceed 5 percent for any of the pectin-adequate formulations. Taken together, the evidence supports adopting 60% sugar, 1.2% pectin, 0.3% citric acid and a 72 °C controlled-boil end-point as the default cottage-scale recipe.

Discussion: The first striking finding is that acceptability peaked at 60% sugar and fell away at both lower and higher levels. This matches Verma's guava leather work that identified an acceptability ceiling between 55 and 62 percent sugar, though leather sits at a different moisture band [6]. The mechanism behind the drop-off above 70% sugar is almost certainly sucrose crystallisation during storage - scanning electron microscopy by Singh *et al.* [7] on 75% sugar guava cheese showed micro-crystals forming by day 30, and panellists in the present research reported exactly that sandy mouthfeel in the S8 and S9 samples. Moving to texture, the 1.2% pectin level delivered the gel network needed for clean slicing without the rubbery feel that 1.5% pectin has been reported to cause [4]. The present hardness value of 34.7 N falls almost exactly between the 32 N reported by Patel [8] and the 37 N recommended in the EMBRAPA guava processing manual [10], suggesting the chosen combination sits squarely in the accepted textural range. The correlation pattern also deserves attention. The strong negative link between moisture and hardness (r = -0.87) was expected, but the weak correlation between sensory score and either hardness or moisture is the more interesting finding - it implies that the panel weighted overall balance, including colour, aroma and aftertaste, more heavily than any single mechanical property. That observation aligns with the multi-attribute preference mapping work of Sharma *et al.* [11] on Brazilian fruit confectioneries. From a practical standpoint, holding the boiling temperature at 72 °C rather than allowing a rolling boil around 95 °C cut browning by 28 percent as judged by Hunter L* values, with no penalty in final Brix or sensory score. Recipe standardization work with this level of process specification has clear implications for the 1,200-odd cottage units across Minas Gerais and Sao Paulo that currently produce guava cheese by eye.

Conclusion: Guava cheese has long been produced at cottage scale without a documented recipe, and inconsistent product quality has limited its retail footprint in a way that other standardized fruit confectioneries have avoided. The present research set out a reproducible recipe and process for guava cheese and tested it across nine sugar ×pectin combinations, with 60 days of storage follow-up. The highlights are a sensory score of 8.6 out of 9 for the optimized S6 formulation, hardness within 5 percent of the artisanal benchmark, a moisture gain held below 1.3 percentage points over 60 days and a near-70 percent reduction in batch-to-batch sensory variability. The practical recommendation to cottage units is direct: adopt 60% sugar, 1.2% pectin, 0.3% citric acid and a controlled 72 °C boil to a 70 °Brix end-point, followed by aluminium laminate packaging and 12 °C storage. Looking ahead, the same framework could be extended to pink-guava cultivars, to sugar-reduced variants substituting stevia or erythritol, and to shelf-life extension beyond the 60-day window tested here. A logical next step is a multi-site producer trial that checks whether the recipe reproduces its advantage across the cultivar and climate variations found across the Brazilian guava belt.

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