



## Development and the physical, chemical, microbiological and sensory analyses of red pepper seasoned with parmesan cheese

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**ABSTRACT.** Pickles comprising red pepper seasoned with Parmesan cheese has been developed as a new type of product developed by family cottage industries. Two formulations were prepared, or rather, with and without the preservative potassium sorbate, which underwent several physical, chemical, microbiological and sensory analyses. Physical and chemical analyses were undertaken for acidity, pH and °Brix; microbiological analyses for total heat-tolerant coliforms, *Salmonella* sp, molds, yeasts; sensory aspects such as physical features, aroma, flavor and texture, coupled to purchase intention among tasters were investigated. Both formulations comprised physical, chemical and microbiological parameters within standards. Sensory evaluation showed satisfactory results and research on purchase intention showed approximately 80% acceptability. Results from physical, chemical and microbiological tests showed that pickled pepper seasoned with Parmesan cheese may be prepared with citric acid as a preservative. Sensory evaluation and purchase intention indicate a real production and sale possibility of pickled peppers seasoned with Parmesan cheese by family cottage industries.

**Keywords:** pepper, cheese, pickled pepper.

## Desenvolvimento, análises físico-químicas, microbiológicas e sensoriais de pimenta recheada com queijo parmesão

**RESUMO.** A elaboração de uma pimenta recheada com queijo parmesão na forma de conserva foi conduzida como uma nova opção de produtos a serem desenvolvidos por agroindústrias familiares. Foram desenvolvidas duas formulações, com adição do conservante sorbato de potássio e sem adição do mesmo, que foram submetidas a diferentes análises físico-químicas, microbiológicas e sensoriais. As análises realizadas englobaram aspectos físico-químicos, como acidez titulável, pH e Brix, análises microbiológicas como, coliformes totais e termotolerantes, *Salmonella* sp, bolores e leveduras e aspectos sensoriais como aparência, aroma, sabor e textura, além de uma análise de intenção de compra por parte dos provadores. Foi constatado que ambas as formulações apresentam parâmetros físico-químicos e microbiológicos dentro dos padrões. A avaliação sensorial apresentou resultados satisfatórios, e a pesquisa de intensão de compra apresentou percentual de aceitabilidade em torno de 80%. De acordo com os resultados obtidos por meio das análises físico-químicas e microbiológicas, pode-se concluir que é possível formular uma conserva de pimenta recheada com queijo parmesão utilizando como conservante o ácido cítrico. A avaliação sensorial e de intenção de compra indicam real possibilidade de produção e comercialização da conserva de pimenta recheada com queijo parmesão por parte de pequenos agricultores.

**Palavras-chave:** pimenta, queijo, conserva de pimenta.

### Introduction

The culture of pepper plants, practically widespread throughout all the regions in Brazil, is one of the best examples of family agriculture and of small farmer-agro-industry integration. Sweet and spicy pepper may be either consumed fresh and may be processed and used in several types of productions in the food industry. Increasing market demand, estimated to be around 80 million reais a year, has stimulated an

increase in cultivated area and the establishment of agro-industries. In fact, the pepper agribusiness is a highly appreciated entrepreneurship in Brazil. Besides supplying the internal market, part of the Brazilian pepper produce is exported as paprika, paste, dehydrated and ornamental modes (EMBRAPA, 2007).

Brazil features some 32 thousand family agro-industries (BONATO, 2008) which account for most of the pepper production. According to Ceretta

(2004), family agriculture is an activity in which the ownership, management and labor are executed by people bound by blood or kinship.

Agro-industries have also tried to bring innovations by producing and selling pickles, sweetmeats and other products in town fairs and on the local market. However, agro-industry success in a highly competitive market is marked by forwarding to the consumer new products characterized by physical, chemical and microbiological quality within the legally established standards coupled to sensory acceptable aspects. The development of red pepper seasoned with cheese for people who appreciate delicate tasty food aggregates value for the consumers and producers alike, besides the health assets involved.

Pepper seasoned with Parmesan cheese is a new product that contributes significantly towards the well-being of agro-industries and pepper consumers. A new product, characterized by quality, acceptability and safety, is thus developed for the market. Besides being an appetizer for all occasion, seasoned pepper may be used for taste-enhancing in pizzas, macaroni and toasts. It may be served fried or baked according to one's taste and imagination.

The capsicum pepper (also known as 'pimenta calabresa' or 'pimenta-chifre-de-veado') which belongs to the Solanaceae family is one of the most cultivated varieties. The fruits are red and spicy when mature and their spiciness is produced by capsaicin mainly present in the membranes, seeds and even the pulp. Capsaicin sensitizes the salivary glands and stimulates the appetite (OLIVEIRA et al., 2000).

Recent research has shown that capsaicin has medicinal properties and is used as wound healer, antioxidant, arteriosclerosis prevention and cholesterol controller, among other characteristics. The regular use of pepper releases endorphin and stimulates the sympathetic nervous system with appetite decrease (ADAMS, 2007; KASBIA, 2005).

Processing and procedures for food conservation may cause an increase and a decrease in antioxidant activities and depends on several factors, such as chemical structure, oxy-reduction potential, storage place and possible interactions with other food components (NICOLI et al., 1999).

Parmesan cheese, also known as Grana, Parmigiano-Reggiano or Grana Padano, hails from the river Pó valley, one of the most traditional places in cheese production in Italy. The cheese matures between one and three years till it becomes tender and brittle. In Brazil Parmesan cheese matures in six months although current Grana-type cheese is industrialized within a 12-month maturation period

(ABIQ, 2005). Cheese is matured at low humidity and low fat rates (MERCOSUL, 1997). According to Perry (2004), it is hard with a compact and consistent texture, granulose surface, a firm, smooth and non-slimy skin, yellowish color, a sweet, slightly spicy taste, featuring tender to strong smell and should be stored at a temperature equal to or below 18°C.

Current paper discusses red pepper seasoned with Parmesan cheese and analyzes the product according to its physical, chemical, microbiological and sensory characteristics.

## Material and methods

The product contained red capsicum pepper (*Capsicum baccatum*), Parmesan cheese, olive oil, basil, oregano and marjoram, produced and bought locally, citric acid (Duas Rodas®) and potassium sorbate used as a fungicide and bactericide preservative.

Two formulations with red capsicum pepper seasoned with Parmesan cheese were tested to identify the best formulation for a preserve with physical, chemical, microbiological and sensorial characteristics according to quality standards established by health laws, coupled to consumers' acceptability tastes.

### Pepper seasoned with Parmesan cheese

Two formulation of pepper seasoned with Parmesan cheese were developed: formulation A without the food preservative potassium sorbate and formulation B with potassium sorbate 0.1%.

Red capsicum peppers were washed, classified and weighed (approximately 110 g) and seeds were removed by pincers.

In the bleaching stage the pepper were placed in boiling water for one minute and then placed in an ice bath for thermal shock. The process was repeated four times.

Peppers were seasoned with Parmesan cheese cut in approximately 2 mm strips and placed in a sterilized glass jar. Seasoned (basil, oregano, marjoram) olive oil was added and acidified. The jar was closed and placed in a warm bath for 25 minutes. The jar was used as standard sample for analyses.

Table 1 shows formulations and their respective ingredients.

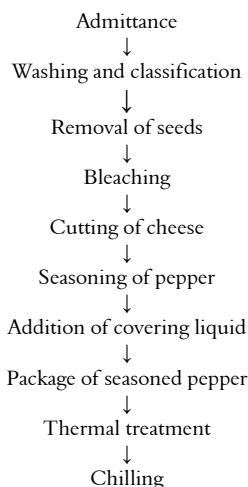
Customary physical and chemical determinations in preserves consist of analysis of total acidity and pH, according to methodology by Analytic Norms of the Adolfo Lutz Institute (IAL, 2004). The determination of lactic acid was

undertaken according to norms on cheese by the Adolfo Lutz Institute (IAL, 2004). Amount of total soluble solids in Brix was calculated by direct reader refractometer ABBÉ Biobrix. All analyses were made in triplicate.

**Table 1.** Formulation of red capsicum pepper seasoned with Parmesan cheese.

| Ingredients             | Formulation A<br>(g 100 g <sup>-1</sup> ) | Formulation B<br>(g 100 g <sup>-1</sup> ) |
|-------------------------|---|---|
| Red capsicum pepper     | 110                                       | 110                                       |
| Standard 'Minas' Cheese | 80  | 80  |
| Compound olive oil      | 90  | 90  |
| Basil                   | 3   | 3   |
| Oregano                 | 3   | 3   |
| Marjoram                | 3   | 3   |
| Citric acid             | 0.67                                      | 0.67                                      |
| Potassium sorbate       | -   | 0.28                                      |

Figure 1 shows processing schedule of pepper seasoned with Parmesan cheese.



**Figure 1.** Processing schedule of seasoned pepper.

#### Determination of most probable number (MPN g<sup>-1</sup>) of total thermo-tolerant coliforms

Microbiological analyses occurred during three months so that shelf test could be undertaken. First microbiological quality analysis was undertaken on the day of manufacture of the preserve and subsequently during the whole period.

The most probable number of total and thermo-tolerant coliforms was determined by high temperature assay using EC medium, following Vanderzant and Splittstoesser (1992). In the above procedure, inoculation was undertaken in three series of three tubes with lauryl sulfate tryptose broth (LST) in the dilutions 10<sup>-1</sup>, 10<sup>-2</sup> and 10<sup>-3</sup> as from dilution 1/10 obtained by the homogenization of 25 g of sample in 225 ml of buffered peptonated water.

After incubation at 35°C, during 48h, in positive tubes of LST with gases in Durham inverted tubes, confirmatory tests for total coliforms in Brilliant Green Bile Lactose broth at 35°C during 48h and for thermo-tolerant coliforms in EC broth at 45°C during 24 – 48h were done. Thermo-tolerant coliforms followed NMP g<sup>-1</sup> of the analyzed sample according to the reading of tubes with EC broth, which produced gases (FDA, 1992).

For *Salmonella* sp., 25 g of sample were weighed and homogenized in 225 mL of peptonated water incubated at 35°C during 24h (LANARA, 1981). The resulting pre-enrichment was heavily seeded with a nickel-chrome loop in xylose lysine deoxycholate agar (XLD agar) and Hektoen enteric agar (Biobrás) incubated at 35°C during 24h (FDA, 1992; VANDERZANT; SPLITTSTOESSER, 1992). Parallel inoculation in triple sugar iron agar (Difco) and lysine iron agar (Difco) (FDA, 1992) was used in suspect *Salmonella* sp. colonies.

Pour-plate in Sabouraud sugar was employed for the analyses of moulds and yeasts, in triplicate in dilutions 10<sup>-1</sup>, 10<sup>-2</sup> and 10<sup>-3</sup>, and incubated in buffer at 25°C 120h<sup>-1</sup> (LANARA, 1981). Results were given by the number of Colony-forming Units per gram of the material (CFU g<sup>-1</sup>).

#### Sensorial test for acceptability and consumption

Sensorial acceptability and consumption test was undertaken in the Laboratory of Food Technology of the Food Engineering course of the State University of Maringá.

Acceptability Test used the 9-score hedonic scale and 50 non-trained volunteer judges participated. Volunteers attributed scores from 1 ('dislike extremely') to 9 ('like extremely') for degrees of acceptability. Data were given in percentages of scores by each judge who attributed scores (% judges).

#### Results and discussion

Physical, chemical, microbiological and sensorial analyses were undertaken to verify which formulation produced the best conditions in manufacturing, preservation and tasters' acceptability.

#### Physical and chemical characteristics

Table 2 gives results on the physical and chemical characterization of red pepper seasoned with Parmesan cheese.

Lactic acid in the two formulations amounted to 0.02 g 100 g<sup>-1</sup> of the product. According to Pimentel et al. (2002), the percentage of lactic acid in Parmesan

cheese ranged between 0.30–3.84 g 100 g<sup>-1</sup>. When compared with results in current analysis, lactic acid rates in the formulations were lower than those by Pimentel et al. (2002) considered as standard. This was due to the total amount of product used in the sample, since total weight of pepper, cheese and seasonings should be taken into account.

**Table 2.** Results on the physical and chemical analyses of red pepper seasoned with Parmesan cheese in formulations A and B.

| Parameters               | Formulation A | Formulation B |
|--------------------------|---------------|---------------|
| Total Titled Acidity (%) | 0.23 ± 0.00   | 0.19 ± 0.03   |
| Lactic Acid (%)          | 0.02 ± 0.00   | 0.02 ± 0.00   |
| pH                       | 3.9 ± 0.13    | 4.3 ± 0.08    |
| Brix                     | 71.6 ± 0.01   | 72.0 ± 0.01   |

According to CNNPA n. 13, of the 15<sup>th</sup> July 1977, amount of citric acid allowed as adjustment agent and pH corrector is that strictly necessary to achieve the desired aim (ANVISA, 1977). In Formulations A and B, pH was within the standards determined by current legislation.

Although the pH rate in B was slightly higher than that in A, it may be due to potassium sorbate which is a highly used preservative in dairies. According to Menezes et al. (2009), the addition of potassium sorbate in food tends to increase pH by approximately 0.1 to 0.5, depending on the added quantity, pH of medium and product type.

Total Soluble Solids (TSS) rate in percentage of weight of fresh material has a high positive correlation with sugar rates and, therefore, is accepted as an important quality factor (BOBBIO; BOBBIO, 2001). °Brix rate in the analyses showed that samples stayed within legal standards which must be lower than 90°Brix for products with cheese in their formulations (BRASIL, 1978).

Rates given by the physical and chemical analyses showed that the two formulations were within legal standards for cheese and preservatives and that there were no statistically significant differences among samples at 5%.

#### Microbiological analysis

Microbiological results on total thermal-tolerant coliforms and research on *Salmonella* sp evidenced total absence of contamination. Preserve failed to manifest any pathogenic micro-biological-produced contamination in the three months of evaluation and thus proved to be a commercially sterile product.

Colony-forming Units counts for moulds and yeasts in Sabouraud agar culture in Formulation A with only citric acid as preservative showed total absence of colonies. On the other hand, Formulation B showed a 3 x 10<sup>2</sup> CFU g<sup>-1</sup> contamination. According to the MERCOSUR

Technical Regulations N° 134/1996, permitted mould and yeast amount is 5 x 10<sup>3</sup> CFU g<sup>-1</sup>. Although slight contamination existed, the product was within the established legal standards. Formulation B was contaminated by moulds in two 2 colonies. According to Franco et al. (1985), low mould and yeast counts are normal (non significant) in fresh and frozen food.

It should be emphasized that Parmesan cheese used in the production of seasoned pepper was not commercialized in bulk on the market but handled by sellers. This fact may have contributed towards its contamination when mould and yeast analyses were undertaken and corroborates the care which should be taken with regard to the place where the product is manipulated, to the seller and storing conditions when foodstuff is concerned. Preservatives merely maintain the product's quality and do not confer any quality to the product when quality is absent in the prime matter.

#### Sensorial analysis

Formulation A was chosen for the Acceptability Test since it showed physical, chemical and microbiological results within legal standards.

The issues analyzed were physical aspects, aroma, taste and texture. Table 3 shows percentages of scores for the above sensorial characteristics

**Table 3.** Percentage of judges who attributed scores for physical aspects, aroma, taste and texture for pepper seasoned with Parmesan cheese.

| Scale                    | % Judges         |       |       |         |
|--------------------------|------------------|-------|-------|---------|
|                          | Physical aspects | Aroma | Taste | Texture |
| Dislike extremely        | 0                | 0     | 0     | 0       |
| Dislike very much        | 0                | 0     | 0     | 0       |
| Dislike moderately       | 0                | 0     | 0     | 0       |
| Dislike slightly         | 2                | 4     | 0     | 0       |
| Neither like nor dislike | 6                | 2     | 2     | 6       |
| Like slightly            | 6                | 4     | 6     | 2       |
| Like moderately          | 16               | 12    | 24    | 16      |
| Like very much           | 38               | 44    | 34    | 44      |
| Like extremely           | 32               | 34    | 34    | 32      |

Highest percentage between 34 and 44% attributed scores which were equivalent to 'like very much' for all factors evaluated. Further, more than 30% of judges evaluated the factors physical aspect, aroma, taste and smell as 'like extremely'. Over 86% of judges approved the product and classified it by scores equal to or higher than 'like moderately' for the four evaluated factors.

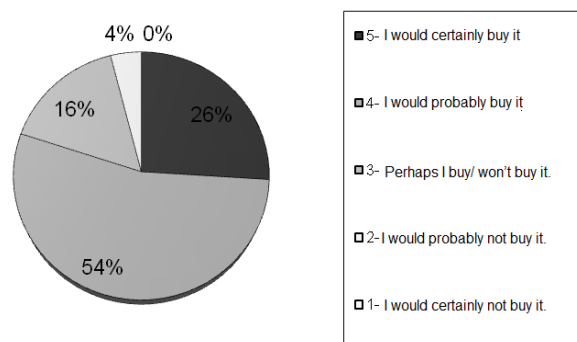
The lowest score was 4, equivalent to 'dislike slightly': 4% of judges attributed the score for aroma and 2% for physical aspects.

Aroma evaluated in pepper seasoned with Parmesan cheese presented satisfactory

distinguishing results since 34% of judges liked it extremely and 44% liked it very much. Texture was also an issue with good approval, 44 and 32% respectively for scores equivalent to 'like very much' and 'like extremely'.

#### Buying survey

Figure 2 shows buying survey and shows buying intention for pepper seasoned with Parmesan cheese.



**Figure 2.** Buying survey on pepper seasoned with Parmesan cheese.

Figure 2 shows the high percentage in buying intention with regard to pepper seasoned with Parmesan cheese, since approximately 80% of surveyed people stated that they would probably or would certainly buy the product. Rejection rate was low, with only 4% of surveyed stating that they would possibly not buy the product.

Results on Table 3 and Figure 2 show the high acceptability rates for the suggested new product. This fact and the physical, chemical and microbiological characteristics feature the possibility of commercialization of pepper seasoned with Parmesan cheese.

#### Conclusion

The product obtained satisfactory results when its characteristics were taken into account.

Physical and chemical analyses showed that acidity, soluble solids and pH comply with current Brazilian legislation. It is therefore possible to formulate a preserve of pepper seasoned with Parmesan cheese with citric acid as preservative.

Microbiological analyses have shown that pepper seasoned with Parmesan cheese has good microbiological qualities since no contamination by any pathogenic microorganism analyzed occurred, whereas moulds and yeasts rates were within the standards of Brazilian health regulations.

Sensorial evaluation and buying intention survey indicated real possibilities of production and commercialization of preserve pepper seasoned with

Parmesan cheese. This is due to its excellent acceptability by consumers.

It should be emphasized that acquisition of high quality prime matter and hygiene during manufacturing and handling of the product are important factors for quality products.

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