Edible gelatin/glycerol coating added with rosemary essential oil (*Rosmarinus officinalis* L.) increases pork loin shelf life

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Abstract
The use of plastic as packaging for food preservation has been questioned due to its great environmental impact. Thus, we seek new alternatives to reduce the non-biodegradable material use and add value to packaged food. The edible coating use is a very viable alternative, not only because it reduces the use of plastic, but also because it acts as an active packaging. Elements that improve its properties, such as the addition of essential oil, can be added to it. This work aims to evaluate the effect of gelatin-based coating with rosemary essential oil addition during 8 days of cold storage of pork loin. The coated samples added with rosemary essential oil obtained better responses in the pH, weight loss, firmness, lipid oxidation, and microbiological growth analyzes, proving to be a great alternative for refrigerated meat conservation. In sensory evaluation, no significant difference was observed between the control and the coated meat.

Key-words: Edible film; *Rosmarinus officinalis* L.; Pork quality; Meat conservation; Meat quality.

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1. INTRODUCTION

Food packaging is used to maintain food quality, providing hygienic and sanitary safety and extending the shelf life of perishable products that are easily contaminated by microorganisms and/or undergo oxidative deterioration (Ahmad, Benjakul, Prodpran, & Agustini, 2012). Food packaging is a subject that is always under the eyes of researchers, seeking to develop and/or improve many of its characteristics that are crucial for maintaining the product quality to be packaged. Intelligent packaging, ie, that seeks to provide a barrier against harmful contaminants and simultaneously contribute to the extension of the shelf life (Holman, Kerry, & Hopkins, 2018).

The increased environmental impact due to the high consumption of conventional petroleum-based plastics is becoming a matter of concern. Therefore, there is a growing interest in the development of environmentally friendly food (Ahmad et al., 2012; Atarés & Chiralt, 2016). For this reason, several polymers are being studied in search of alternative packaging materials. Biodegradable films and coatings symbolize an attractive alternative for reducing the use of non-biodegradable plastic materials (Atarés & Chiralt, 2016). Edible coatings are defined as a thin layer of material formed on the surface of food, derived from natural sources to protect and prolong shelf life. They act as a barrier inhibiting gas exchange, controlling the rate of respiration and preventing the growth of microorganisms that can cause deterioration of the product (Debeaufort, Quezada-Gallo, & Voilley, 1998; Tokatlı & Demirdöven, 2020; Yuan, Chen, & Li, 2016).

One of the biopolymers already known for their excellent film-forming ability is gelatin, a compound obtained from collagen hydrolysis generated from animal slaughter and fish processing. Among its main characteristics we can mention the light and oxygen barrier, which leads to the preservation of dehydration and lipid oxidation. Therefore, their application as coating or packaging may keep the food quality during storage (Ahmad et al., 2012). There are some recent studies using gelatin in the production of meat coating films, such as beef (Battisti et al., 2017; [illegible]ridi et al., 2018), tilapia fillets(Zhao, Wu, Chen, & Yang, 2019), rainbow trout (Nowzari, Shabanpour, & Ojagh, 2013), golden promfret fillet (Feng, Bansal, & Yang, 2016), shrimps (Alparslan et al., 2016; Farajzadeh, Motamedzadegan, Shahidi, & Hamzeh, 2016), grass carp fillets (Sun et al., 2019), salmon nigiri (Kulawik, Jamróz, Zając, Guzik, & Tkaczewska, 2019), pork (Kaewprachu et al., 2018) and brisket fillet (Moreno, Atarés, Chiralt, Cruz-Romero, & Kerry, 2018), and obtained quite satisfactory results in their research based on the functions performed by the coating.

While thinking about sustainability and more environmentally friendly methodologies, reducing the chemical additives use by industry is also a major issue in product development, as interest in the natural additives application with properties antioxidant and antimicrobial has grown, which are not harmful to human health (Atarés & Chiralt, 2016), as an example of essential oils (EO). However, there is a major limitation in the EO use due to its application costs, its intense aroma, which may negatively affect the sensory characteristics of the food.

In this sense, coatings are promising systems for active ingredients incorporation, among them the OE, which stand out due to its high biological activity, and also because many of them are classified as GRAS (Generally Recognized the safe) by the FDA (Yuan et al., 2016). Another positive point of using EO is that this material is very effective at very low concentrations (Sánchez-González, Vargas, González-Martínez, Chiralt, & Cháfer, 2011). Two factors are bringing popularity to the EO application in coating, its lipid nature, it is believed that will help reduce the water vapors permeability, enhancing the barrier capacity; and its volatility, which facilitates the use of small concentrations that are safe for consumption (Atarés & Chiralt, 2016; Yuan et al., 2016). In addition, it adds antioxidant and/or antimicrobial effects on the coating (Atarés & Chiralt, 2016).

The rosemary EO (Rosmarinus officinalis) is widely used in the industry as a flavoring, fragrances and medicines, among other applications. Several uses of this herb have been reported in traditional medicine for treating illnesses, painkillers, tonic to improve memory dysfunction and extensive physical or mental work. In addition to being known as insecticide and herbicide. Studies already conducted using this EO have proven antioxidant, antimicrobial, hepatoprotective, antitumor, and hypoglycemic-hypolipidemic activity (Arranz et al., 2015; Karadağ et al., 2019). The presence of phenolic compounds in rosemary composition such as rosmarinic acid, carnosol, carnosic acid and α-pinene, bornylacetate, 1,8-sineol may be the main responsible for the biological activity of the extract (Arranz et al., 2015; Karadağ et al., 2019; Satyal et al., 2017).

This research aimed to evaluate the effect of the biodegradable edible gelatin coating with rosemary essential oil addition on the shelf life control of chilled pork loin, evaluated by microbiological and physicochemical characteristics.

2. MATERIAL AND METHODS

2.1. Materials and Methods

The gelatin used was a commercial type B gelatin (Bloom 250, Gelita do Brasil - Cotia, SP, Brazil) donated by the company Gelita do Brasil. The glycerol and pork loin were obtained from local commerce in the region (Rio Paranaíba, MG, Brazil) and sliced in approximately 20 mm thick. The rosemary (*Rosmarinus officinales)* samples were acquired in the central market of Belo Horizonte – MG, Brazil.

2.1.1. Extraction of rosemary essential oil

The essential oil was extracted from the leaves by hydrodistillation for two hours using a modified Clevenger apparatus coupled to a 6 L round bottom flask. The hydrolact was separated by centrifugation in a horizontal crosshead centrifuge at 1100 g for 5 min. The essential oil was removed with the aid of a Pasteur pipette and transferred to a glass vial, which was wrapped with aluminum foil and stored under refrigeration (ANVISA, 2010).

2.1.2. Coating preparation and application

The coating solution was prepared by solubilizing gelatin and glycerol (10: 1) in 500 mL of distilled water heated to 70 °C and stirred for 10 minutes. The solution was cooled to [illegible] ºC for the rosemary essential oil addition, two oil concentrations in relation to the gelatin solution were used, being 0.4 mg.L^{-1} and 0.8 mg.L^{-1}. The coating application on the pork loin was performed by immersion in the solutions so that the coating for 5 seconds and suspended on hooks for 30 minutes in a climatic chamber at 4 ºC for direct coating polymerization on the meat surface.

The coated loins were individually weighed, packaged in polypropylene trays and wrapped in polyvinyl chloride (PVC) oxygen permeable film and stored at a controlled temperature of 4 ± 0.5 °C. The obtained samples were designated as: T1: loin coated with gelatin / glycerol coating added 0.4 mg.L^{-1} of rosemary essential oil; T2: Loin coated with gelatin / glycerol coating added 0.8 mg.L^{-1} rosemary essential oil; T3: Loin coated with gelatin / glycerol only; and C: control loin sample.

The described analyzes were performed with 0, 2, 4, 6 and 8 days of storage, except for the lipid and sensory oxidation analysis, performed with 0, 4 and 8 days of storage.

2.1.3. Physicochemical analysis on pork loin

2.1.3.1. Determination of weight loss

To monitor weight loss during the storage process, the pork loins were weighted back in a semi-analytical balance and the packing weight was deducted to obtain the real weight of the pork loin. The results were expressed as percentages of weight lost relative to the initial one (day 0).

2.1.3.2. Determination of firmness

The firmness was analyzed by checking the force required for muscle tissue disruption using a manual firmness analyzer (model PTR-300, Instrutherm) with a 5 mm diameter tip.

2.1.3.3. Determination of pH

The pH was measured at different points of the samples using a digital pH meter (Model JK - PHM - 005) equipped with a puncture glass electrode.

2.1.3.4. Centesimal composition

To evaluate the samples' centesimal composition, moisture, ash and two of the main macronutrients (lipids, proteins) analyzes were performed using the Soxhlet and Kjeldahl method, respectively. The methodologies used are described in the Manual of Official Methods for Analysis of Animal Food (Brasil & Ministério da Agricultura Pecuária e Abastecimento, 2017).

2.1.4. Microbiological analysis on the pork loin

Populations of total coliform (TC), thermotolerant coliform (TTC), molds and yeasts (MY) and psychrotrophic bacteria (BP) were monitored during storage, following the Official Analytical Methods for Microbiological Analysis for Control of Animal Products and Water (Brasil & Ministério da Agricultura Pecuária e Abastecimento, 2017). Triplicate samples of 5 g of each steak were obtained aseptically, 45 ml of 0.1% (w / v) sterile and homogenized peptone water were added, obtaining dilution 10-1, diluted in decimal series to 10-2 sown in the following conditions: TC analysis and TTC was divided into two procedures, first to the TC test suspected colonies were inoculated into Broth Bright Green (BBG) 2% lactose and incubated (with of Durhan tubes inverted in the tubes of growth) at 36 °C / 24-48 h, according to the test TTC suspected colonies were inoculated into EC broth and incubated (with of Durhan tubes inverted in the tubes of growth) at 45 °C / 24-48 h. Positive results were verified by the gas presence in Durhan tubes and expressed as NMP / g or mL. While MY were determined on dextrose potato agar (acidified with 10% tartaric acid) after incubation at 25 °C for 5 days. BP was plated by a Spread plate on plates with PCA (Plate Count Agar) agar incubated for 10 days at 7ºC. Results are reported as colony forming units per gram of food in (CFU / g).

2.1.5. Lipid oxidation of pork loin

The peroxide value was the factor used to evaluate the lipid oxidation in the pork loin during storage. The methodology used was proposed by the National Agricultural

Laboratory / Animal Products (MAPA/SDA/CGALI, 2014), in which the fat mass obtained was used in the storage. Eq. 1 for the calculation of the peroxide value.

$$\text{Proxide value (mEQ/kg)} = ((V-B) \times C \times f \times 1000)/m \qquad \textbf{Eq.1}$$

V = volume (mL) of sodium thiosulfate spent on titration; B = volume of sodium thiosulfate solution spent on blank titration (mL); C = Concentration of sodium thiosulfate solution; f = sodium thiosulphate solution correction factor; m = sample mass in grams or sample mass in aliquot.

2.1.6. Consumer study

Sensory analysis was performed after approval by the Ethics Committee of the Federal University of Viçosa, Brazil, under protocol number 1.81[illegible]0. Fifty untrained participants of both sexes and over 18 years old from the Federal University of Viçosa, Brazil, evaluated the pork loins under the same retail conditions, in monadic order, presented randomly in a single test session. Participants evaluated the attributes appearance, color, overall impression and purchase intent using a 9-point hedonic scale (9 = extremely liked, 1 = extremely disliked) and 5 points (5 = certainly would buy, 1 = certainly would not buy) for the first three attributes and for global intent, respectively.

2.1.7. Statistical analysis

Statistical analysis was performed using Software R, version 3.2.2. Analytical data were reported as mean ± standard error of independent measurements and submitted to analysis of variance (ANOVA). Tukey test was applied to compare the means in samples with 5% probability level of variance. For sensory evaluation, ANOVA was performed with taster and treatment as independent variables (random and fixed variables, respectively), and hedonic scores corresponding to an individual sensory attribute as the dependent variable. The Tukey test was also applied to compare the means.

3. RESULTS AND DISCUSSION

3.1. Changes in pH and microbiological analysis on the pork loin

The interaction between coating type x storage time had significant effect for pH analysis. The increase in pH values was noticeable for all samples analyzed during the storage time (Figure 1). The increase in pH during the 8 days in refrigeration can be associated with the accumulation of Ammonia and amines in the samples, possibly caused by microbial secretion of proteolytic enzymes (Lorenzo, Batlle, & Gómez, 2014; Wu et al., 2019). The aerobic storage conditions may have favored the development of deteriorating microorganisms in porcine loins (Cardoso et al., 2019; Ntzimani, Paleologos, Savvaidis, & Kontominas, 2008).

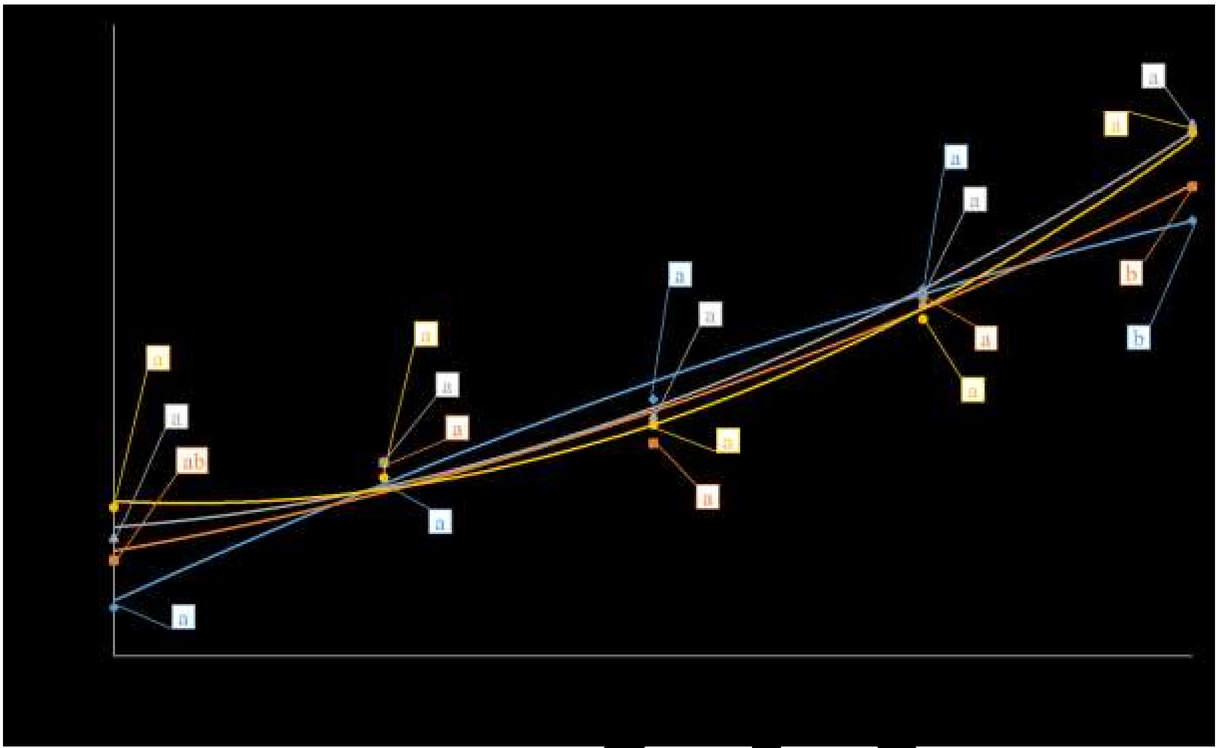

Figure 1. pH profile of gelatin-coated pork loin for 8 days of storage.

Values with different letters on the same day of storage showed significant difference (p <0.05) by Tukey test. T1 (◆): Gelatin coated samples added with 0.4 mg.L^{-1} rosemary essential oil; T2 (■): Gelatin-coated samples added with 0.8 mg.L^{-1} rosemary essential oil; T3 (▲): Samples coated with gelatin only; and T4 (●): Control.

There are several sources for contamination of pork loin samples such as air pollution, manipulation, utensils contaminated and contamination already present on the meat surface. The availability of oxygen and nutrients may have facilitated the growth of bacteria, which possibly degraded proteins, releasing alkaline compounds, which increased the pH value (Feng et al., 2016; Ruan et al., 2019)

This behavior in pH analysis has been observed in other studies using fresh meat coatings (Cardoso et al., 2019; Jridi et al., 2018; Kaewprachu et al., 2018; Ruan et al., 2019). Therefore, the pH increase in the coated pork loin was lower than in uncoated samples, which may indicate less contamination.

The contamination of samples is confirmed after microbial evaluations (Figure 2). The TC, TTC, and MY and BP there was a significant effect of the interaction between coating type x storage time (p <0.05). The TC count increased during storage, being higher in gelatin coated samples without rosemary essential oil and in the control sample (T3 and T4). For TTC, values from 1.21 × 10^{1} to 4.1 × 10^{1} CFU / g were obtained on the eighth day of storage, and the samples with the addition of rosemary essential oil (T1 and T2) with the lower count, showing that treatments were effective in inhibiting microbial growth.

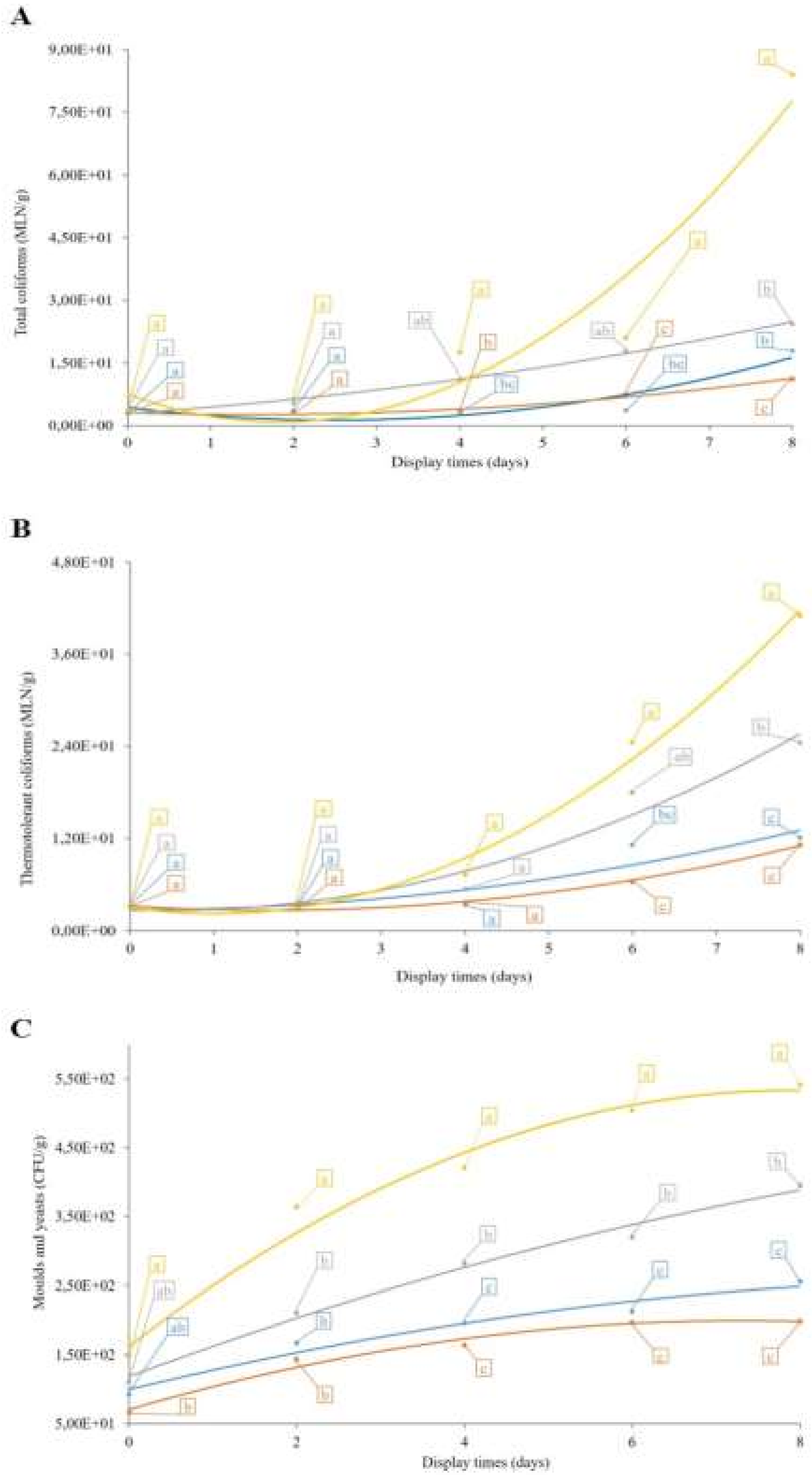

Figure 2. Microbial evaluation of TC (A) TCC (B) and MY (C) in gelatin coated pork loin.

Values with different letters on the same storage day show significant difference ($p < 0.05$) by Tukey test. T1 (◆): Gelatin coated samples added with 0.4 $mg.L^{-1}$ rosemary essential oil; T2 (■): Gelatin-coated samples added with 0.8 mg.L^{-1} rosemary essential oil; T3 (▲): Samples coated with gelatin only; and T4 (●): Control.

Microorganisms of the coliform family are directly linked to the sanitary quality of slaughtering and food processing facilities, making their evaluation fundamental. Pork loins contamination was already expected, based on the fact that meat is a very conducive food to contamination (Oliveira, et al. 2008). The profiles found for microbiological analyzes are similar because there is no significant difference between the microorganism growth from the fourth day of evaluation, in which the samples containing the gelatin coating without the addition of essential oil and the control sample had more values high contamination. Characterizing the coating with the addition of rosemary essential oil as effective in controlling these microorganisms.

Rosemary essential oil has already been tested in other experiments against the development of TTC by Jiang, Liu, & Wang (2011), in which damage to the cell wall of the microorganism was observed, with extravasation of cell content and concave shaped cells from increased concentration of rosemary essential oil. [illegible] by Santurio et al. (2011), using beef and poultry, and confirmed the rosemary essential antifungal action by evaluating the non multiplication of these microorganisms when applied to fresh samples. This characteristic can be explained by the presence of monoterpene compounds in rosemary essential oil, such as thymol and carvacrol, which are responsible for causing alteration in the microorganisms cell membrane lipid part, penetrating it and interacting at critical sites for microbiological activity ([illegible] & Deans, 2008).

The growth of psychrotrophic bacteria presented a similar profile to the other microorganisms evaluated, having for the coated samples added with rosemary essential oil a smaller growth, having in the last day of storage values of 1,33 × 10^{-5} and 3,05 × 10^{-5} CFU / g for samples with 0.8 mg.L^{-1} and [illegible] mg.L^{-1}, respectively. Showing good control in the growth of these microorganisms. In gelatin-coated samples without rosemary essential oil, growth control was observed only by compared with the control sample, however, the count was still high, with 1.21 × 10^{-7} CFU / g on the last day, not too far from control treatment which was found [illegible] × 10^{-7} CFU / g.

Therefore, the control of pH variation in coated samples during 8 days of storage may be due to the protective activity of gelatin coating against porcine loin decomposition, resulting in lower microbial growth than that observed in control samples. In addition, the efficiency of rosemary essential oil can be seen from the low results obtained from microbiological growth. However, the storage temperature already exerts control on microbiological development, increasing the latency phase of microorganisms, causing their growth delay. Thus, the application of methods to decrease the microbial growth in fresh meat is very effective and promising, although, it is still necessary to monitor the quality control inside the processing plant, ensuring the health and quality of fresh meat.

3.2. Physicochemical analyses

3.2.1. Changes in weight loss and firmes value

Weight loss is a limiting indicator of the fresh meat quality during cold storage, which may cause changes in color, taste, and texture. Moreover, it is related to profitability, so it is highly relevant to industry and consumers. The weight loss was significantly affected by the coating type and storage time separately (Table 1). During the 8 days of storage, less weight loss was observed in gelatin-coated pork loins with or without rosemary essential oil, differing only from those that were not coated.

Table 1. Centesimal composition of gelatin coated pork loin

	Moisture (g/100g)	Ash (g/100g)	Proteins (g/100g)	Lipids (g/100g)	Weightloss (%)	Firmness (N)
T1	73,32 ± 0,76 a	1,24 ± 0,35 *	14,29 ± 0,66 *	5,97 ± 0,82 *	2,43 ± 0,15 a	6,86 ± 0,61 a
T2	72,68 ± 1,22 a	1,31 ± 0,45 *	14,34 ± 0,43 *	5,90 ± 0,63 *	2,40 ± 0,12 a	6,71 ± 0,43 a
T3	72,75 ± 0,24 ab	1,26 ± 0,30 *	14,38 ± 0,27 *	5,78 ± 0,49 *	2,[illegible] ± 0,24 a	6,96 ± 0,66 a
T4	71,73 ± 0,91 b	1,33 ± 0,21 *	14,19 ± 0,48 *	5,88 ± 0,66 *	3,67 ± 0,39 b	6,40 ± 0,56 b

Values with different letters in the same column show significant differences ($p < 0.05$) and (*) non-significant differences. T1: Gelatin coated samples added with 0.4 $mg.L^{-1}$ rosemary essential oil; T2: Gelatin-coated samples added with 0.8 $mg.L^{-1}$ rosemary essential oil; T3: Samples coated with gelatin only; and T4: Control.

The weight loss control of gelatin-coated samples was lower possibly due gas permeability and water vapor inherent in food coatings (Kaewprachu et al., 2018). In particular, the gelatin coating added rosemary essential oil showed the best ability to control weight loss.

During storage, fresh meat tends to release exudate, which was not noted in the coated samples. The absence of exudate is very important for consumer evaluation for the purchase of the product, since the release of liquid in the packaging makes it less attractive. Increasing gelatin concentration helps reduce water diffusion in biopolymers. And, the high surface tension of the gelatin aids in repelling water (Antoniewski, Barringer, Knipe, & Zerby, 2007). This was confirmed by (Cardoso et al., 2016) in their gelatin and chitosan coating experiments, where less weight loss was observed in steaks coated with higher gelatin concentrations.

As well as weight loss, pork firmness evaluated were affected by coating type and storage time separately (Table 1). Firmness decreased over the storage time for all samples, with the uncoated sample being the only one that significantly differed among the others, with greater cold softening at the end of storage.

Of all the attributes of meat, texture represents one of the most important to the consumer (Gerelt, Ikeuchi, Nishiumi, & Suzuki, 2002), and is directly related to the protein content of meat. Postmortem protein breakdown occurs as a result of endogenous proteolytic enzymes action causing a weakening of the myofibrils structure and associated proteins, resulting in meat softening (Kaewprachu et al., 2018). About 60-70% of total protein in meat is myofibrillar protein, whose primary role is structural, as most water in muscle fiber is stored between and within myofibrils (Y. Zhang & Ertbjerg, 2018). Regarding meat softening caused by the degradation of myofibrillar proteins, calpains are believed to be the most important enzymes (Y. Zhang & Ertbjerg, 2018). Its activity is directly related to the main attributes of meat quality (beef, sheep, and pork), such as sensitivity, juiciness, loss of cooking and color of cooked and fresh meat (Baur et al., 2015).

As evidenced by the pH and microbial contamination evaluation, the pork loin samples were contaminated at the end of the storage time, a fact that may explain the meat softening. In general, the growth of bacteria resistant to refrigeration temperature correlates with the production of extracellular enzymes, which can degrade muscle fibers, leading to softening (Baur et al., 2015). These enzymes are mainly excreted by fungi and bacteria (Ozturkoglu-Budak, Wiebenga, Bron, & de Vries, 2016), microorganisms that were present in the samples at the end of storage.

3.2.2. Centesimal composition value

Statistical evaluation was performed for each component analyzed within the days of analysis, to facilitate the perception of possible changes in the composition of pork loin during cold storage (7 ºC). There was no significant effect of the parameters evaluated for protein, lipid and ash analyzes. Moisture was significantly affected by coating type (**T**able 1), ie, different results were found for the coated samples compared to the control sample.

3.3. Changes in lipid oxidation values of pork loin

Lipid oxidation is a major cause of the loss of quality of meat and meat products. This parameter was evaluated from the peroxide value, which evaluates the primary fatty acid oxidation level, and was performed soon after film polymerization in the samples (T0) and later on the fourth (T4) and eighth (T8) storage days (Table 2). The peroxide value determines the number of hydroperoxides formed as primary products of self-oxidation that occur based on the meat storage conditions (Medić et al., 2018). That is, lower values for the peroxide index indicate that the samples underwent less oxidation during storage.

Table 2. Peroxide content of gelatin-coated pork loin.

	Day 0	Day 4	Day 8
T1	1,17±0,0[illegible] a	1,97±0,39 a	2,71±0,12 b
T2	1,00±0,08 a	1,83±0,35 a	2,29±0,13 b
T3	1,51±0,14 a	3,37±0,23 a	5,15±0,08 a
T4	1,67±0,24 [illegible]	3,61±0,28 a	5,82±0,60 a

Values with different letters in the same column show significant differences ($p < 0.05$). Day 0 represents the first day the start of the experiment; Day 4 represents the fourth day; Day 8 represents the eighth day. T1: Gelatin coated samples added with 0.4 mg.L^{-1} rosemary essential oil; T2: Gelatin coated samples added with 0.8 mg.L^{-1} rosemary essential oil; T3: Samples coated with gelatin only; and T4: Control.

At T0 and T4, the evaluated samples showed no significant difference, characterizing the oxidation rates as statistically equal. However, in T8 there was a significant difference between the gelatin coated samples added with rosemary essential oil, in both proportions, compared to the gelatin coated and uncoated samples only. This means that the samples containing 0.8 mg.L^{-1} and 0.4 mg.L^{-1} had lower values of lipid oxidation and the other samples (coated gelatin only and without coating) presented higher values, indicating higher oxidation lipid. These results suggest that the rosemary essential oil use promoted antioxidant effect, being effective in controlling the auto-oxidation of the samples during storage.

The literature regarding the oxidation degree determination and fat peroxide value of different types of meat is scarce and interpreted differently. Meat has natural endogenous antioxidants and prooxidants and living cells have several protection mechanisms against oxidation, ie, the superoxide dismutase enzyme responsible for protection against damage caused by the superoxide anion radical and also the enzymes catalase and glutathione peroxidase, which are mainly responsible by removing the peroxide radical (Moreira, Oliveira, Silva, & Saraiva, 2019; J. Zhang et al., 2016).

3.4. Changes in sensorial analysis

The application of affective tests is equivalent to the subjective manifestation of the judge about the food tested, demonstrating the degree of consumer satisfaction, either positive or negative. The results obtained from the application of these tests are difficult to interpret since is of a personal manifestation that may have higher variability in the results. The visual presentation is usually the first user contact with the product, in detail for color and appearance. The consumer when searching for a product already visualizes some of its characteristics, such as appearance and color, in order to please itself so that they can consume it. This expectation is associated with personal reactions of rejection, indifference, and acceptance (Teixeira, Meinert, & Barbosa, 1987).

Sensory evaluation was performed according to acceptable visual attributes of meat quality for consumers. The results obtained from the visual evaluation for the attributes appearance, color, overall impression, and purchase intention are shown in Table 3. The statistical study of the results obtained from the tasters' answers was performed individually at each analysis time, taking the factors treatment and tasters, it is characterized as not significant for any of the attributes as well as purchase intent.

Table 3. Sensory evaluation of color, appearance, overall impression and purchase intention attributes of gelatin-coated pork loins

	Attributes	**Display times (days)**		
		0	**4**	**8**
T1	**Color**	73,78 *	71,44 *	67,89 *
T2		74,11 *	71,11 *	70,89 *
T3		78,89 *	70,11 *	69,89 *
T4		80,44 *	72,22 *	69,67 *
T1	**Appearence**	73,56 *	74,56 *	66,56 *
T2		75,56 *	71,11 *	68,00*
T3		82,56 *	65,56 *	64,78 *
T4		78,33 *	74,56 *	63,44 *
T1	**Overall impression**	72,56 *	74,11 *	68,11 *
T2		74,11 *	70,11 *	68,56 *
T3		82,00 *	69,78 *	67,67 *
T4		77,78 *	74,56 *	67,22 *
T1	**Purchase intention**	77,60 *	76,20 *	66,60 *
T2		81,80 *	76,60 *	71,40 *
T3		81,00*	69,00 *	64,80 *
T4		81,80 *	70,40 *	63,80 *

(*) Not significant difference according to the statistical test. T1: Gelatin coated samples added with 0.4 mg.L^{-1} rosemary essential oil; T2: Gelatin-coated samples added with 0.8 mg.L^{-1} rosemary essential oil; T3: Samples coated with gelatin only; and T4: Control.

The results show that on the first day of evaluation, the samples obtained values higher than 70%, showing a good acceptance by consumers. On the fourth day of storage, the values decrease, characterizing some modification in the samples sensorially perceived by the judges. And finally, on the last day of analysis, the values decreased even more, although there was no statistical difference, showing that the product acceptance decreased during the storage time. This result was expected, since the meat when stored for long periods has some of its characteristics changed. It was also evident that the coating, with or without essential oil, had no significant difference under the control sample. That is, the coating was not effective in maintaining the sensory characteristics evaluated by the acceptance test applied.

However, judges noticed a change in meat color, especially for the control treatment on the last day of storage (eighth day). Many of the judges reported loss of color and appearance of slimy. This can be explained by the microbiological development in meat, which had already been verified from the microbiological analysis of the loins. The production of a viscous film on meat occurs due to the high development of anaerobic yeasts. In addition, microbiological growth may result in increased acidity, production of various volatile organic compounds that directly influence meat odor and taste, as well as changes in color and toxin production (Moreira et al., 2019).

4. CONCLUSIONS

The application the edible coating of rosemary essential oil added gelatin is a viable alternative for quality control of pork loin. Only the coating would already bring major improvements in its characteristics, however, the rosemary essential oil use in the composition of the coating further enhanced its beneficial effects on the coated product conservation. Food packaging goes beyond the basic function of protecting the product and can be used to maintain and enhance its characteristics. Packaging characteristics and packaging-related products influence consumers' intentions and purchasing decisions. Thus, not only the hygienic-sanitary characteristics and physical-chemical stability need to be adequate, but the appearance and color are also important factors, and as pointed out by sensory evaluation, the coating does not influence these aspects, positively affirming its application.

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