Effect of Myrtle (*Myrtus communis*) Extracts on Storage Stability of Chicken Frankfurters

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Abstract: The antioxidant and antimicrobial effects of water myrtle extracts (0.25 and 0.50%) were investigated against lipid oxidation (tiobarbituric acid reactive substances – TBARS) and microbial growth in vacuum-packed chicken frankfurters stored at 4±1ºC for 35 days. The effects of this extract on compositional, physicho-chemical and sensory characteristics of chicken frankfurters were also determined. Results showed that water myrtle extracts possess antioxidant (lower TBARS values that remained stable during the 35 days of storage) and antimicrobial properties (lower aerobic plate count) that may make them useful in the food industry. The addition of water myrtle extracts to frankfurters increased red/green and yellow/blue coordinates and decreased lightness values, which could indicate that *Myrtus comunnis* extract can also acts as a colorant in this type of meat products. Frankfurters with water myrtle extracts were scored similar to controls for overall appearance.

Keywords: Antimicrobial, antioxidant, natural extracts, *Myrtus comunnis,* food preservation.

INTRODUCTION

Chicken meat and its products have experienced increasing popularity and become widely spread all over the world. It is due to, among others, its relatively low cost of production, low fat content and high nutritional value [1]. Chicken sausages, especially chicken frankfurters, are one of the most popular foodstuffs among these products. Frankfurters are non-fermented, emulsion type sausages. They are usually formed by chopping meats, along with other ingredients and with the application of smoke.

Lipid oxidation and bacterial contamination are the main factors that determine food quality loss and shelf-life reduction. Therefore, delaying lipid oxidation and preventing bacterial cross-contamination are highly relevant to food processors [2]. The growth of microorganisms in meat products may cause spoilage or foodborne diseases. Comminuted poultry products contain microorganisms as a result of handling, incorporation of contaminated raw material and ingredients, and contact with equipment. Oxidative processes in meat lead to the degradation of lipids and proteins which, in turn, contribute to the reduction of the nutritional value, deterioration in flavour, texture and colour of displayed meat products [3]. Poultry meat is particularly sensitive to oxidative deterioration because it contains mostly unsaturated fats [2].

Although synthetic additives have been widely used in the meat industry to inhibit both lipids oxidation and microbial growth, the trend is to decrease their use because of the growing consumers concerns [4]. Therefore, the search for natural products with both antioxidant and antimicrobial activities has become a significant field in the food industry. Lately, much attention has been focused on extracts from herbs and spices which have been used traditionally to improve the sensory characteristics and extend the shelf-life of foods [4-6].

Myrtle (*Myrtus communis* L.) is an evergreen shrub belonging to the family of Mirtaceae that grows spontaneously throughout the Mediterranean area. Different parts of the plant find various uses in the food industry, such as for flavouring meat and sauces, and in the cosmetic industry [7]. Myrtle is a very aromatic plant because of the high essential oil content of its leaves, flowers and fruit glands. Myrtle extracts have been reported to possess antibacterial activity, against food-borne pathogenic and spoilage bacteria [8] and antioxidant activity [7, 9, 10]. Consequently, application of this plant may be useful for maintaining meat quality and extending shelf-life.

The objective of this study was to evaluate the effectiveness of water myrtle extract (WME) in delaying lipid oxidation, preserving the colour and improving the

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shelf life of vacuum-packed chicken frankfurters stored at 4 ºC.

MATERIALS AND METHODS

Plant Materials

Myrtus communis L. (Myrtaceae) leaves were collected from the Chefchaouen region (NW Morocco; 35º10'17·N5º16'11·W) during the vegetation period (spring). The taxonomic identification of plant material was confirmed by Abdeslam Ennabili (from PAMSN Laboratory, National Institute of Medicinal and Aromatic Plants, Sidi Mohamed Ben Abdallah University, 34 025 Mezraoua, Morocco). The materials were dried in an oven (Digitheat-TFT, Selecta, Barcelona, Spain) at 35ºC and then the leaves of plants were separated and ground in a grinder (A320, Moulinex, Alencon, France).

Preparation of Extracts

Dried powders of *M. communis* leaves were extracted with water. Twenty five g aliquot of each dried sample was extracted using 100 mL of boiling water for 15 min using a water bath. The extracts were filtered through a filter paper (Whatman #1) and the water was eliminated using a rotary evaporator (Heating Bath B-490, Rotvapor R-200, Buchi, Flawil, Switzerland) to obtain a dry extract. The extracts were stored at -20°C until use.

Formulation and Preparation of Chicken Frankfurters

The frankfurters were manufactured according to a traditional formula (only meat percentages add up to 100% and percentages of others ingredients are related to meat): chicken breast meat (75%) and skin (25%), 15% water (ice form w/w), 3% potato starch (w/w), 2.5% sodium chloride (w/w), 300 mg/Kg sodium tripolyphosphate, 150 mg/Kg sodium nitrite, casein 1.5% and spices (mixture of black pepper, mace, coriander, ginger**,** cardamom and garlic powder). This original mixture was divided in 4 batches: batch 1 was used as control sample, in the batch 2, 0.2 ml/kg of liquid smoke was added, in batch 3 and 4, 0.25% and 0.5% of water myrtle extract were added, respectively. Two replications of this elaboration process were performed.

The products were prepared in the IPOA Research Group Pilot Plant at the Miguel Hernández University according to industrial processing. The chicken breast meat and skin were ground in a cutter (1094-Homogeneizer, Tekator, Höganäs, Sweden) and mixed with the sodium chloride and other ingredients for 2 min (temperature below 12ºC). After homogenization, the resulting mixture was stuffed into cellulose frankfurter casings (19 mm; Fibran, Girona, Spain). The chicken frankfurters were cooked in a water bath to an internal temperature of 72ºC. A thermocouple probe (Omega Engineering, Inc., Stamford, CT) positioned in the geometric center of the chicken frankfurters was used to monitor product temperature. When the endpoint temperature was achieved, the frankfurters were immediately chilled in ice for 5 min. The frankfurters were peeled by hand and vacuum packed (vacuum machine: Egarvac, Barcelona, Spain; packaging film: high barrier film of water vapor permeability 1.1 g/m^2/24 h at 23ºC/50%RH, nitrogen permeability 2.7 cm^3/m^2/24 h at 23ºC/50%RH, carbon dioxide permeability 23 cm^3/m^2/24 h at 23ºC/50%RH and oxygen permeability <5 cm^3/m^2/24 h at 23ºC/50%RH from W.K. Thomas Spain S.L., Rubí, Barcelona, Spain). All samples were stored immediately after packing at 4ºC until further analysis. Figure **1** shows a brief summary in pictures of the process.

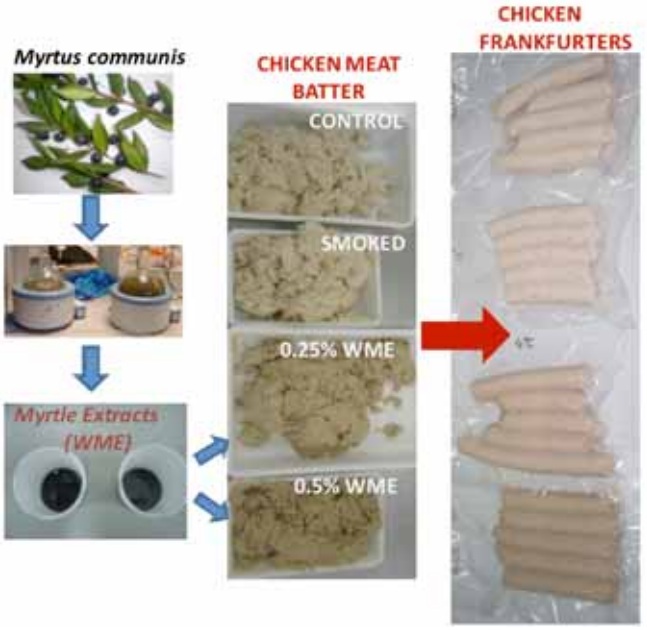

Figure 1: Brief summary (in picture) of the vacuum-packed chicken elaboration process.

Proximate Composition

Moisture, crude fat, total protein and ash of chicken frankfurters were determined applying AOAC methods [11].

Physico-Chemical Analysis

The pH of chicken frankfurters was measured directly using a Crison combination electrode probe

(Cat. No. 52) connected to a pH-meter (model 507 Crison, Barcelona, Spain). The measurement was taken three times, changing the insertion place of the electrode.

Water activity (a_w) was measured at 25ºC using an electrolitic hygrometer (Novasina TH-500, Novasina, Axair Ltd., Pfaeffikon, Switzerland).

For color determination, the frankfurter samples were cut into slices of 2-cm thickness (n=9 for each treatment) and measured by a Minolta CM-2002 (Minolta Camera Co., Osaka, Japan) spectrophotometer with illuminant D_{65}, 10° observer, SCI mode, 11 mm aperture of the instrument for illumination and 8 mm for measurement. The following CIELAB color coordinates were determined: lightness (L*), redness (a*, +/- red-green) and yellowness (b*, +/- yellow-blue). Spectrally pure glass (CR-A51, Minolta Co., Osaka, Japan) were put between the samples and the equipment.

Texture profile analysis (TPA) was performed with a Texture Analyser (TA-XT2, Stable Micro Systems, Surrey, England). The samples were cut in 1 cm high cylinders (n=12) and subjected to a 2-cycle compression test. All instrumental texture analyses were conducted on chilled (4°C) samples. The samples were compressed to 70% of their original height through a 2-bite mechanism at a compression load of 25 kg, and a cross-head speed for 20 cm/min. The texture profile parameters Hardness (g) = maximum force required to compress the sample; Cohesiveness = Extent to which sample could be deformed prior to rupture (A2/A1, A1 being the total energy required for the first compression and A2 the total energy required for the second compression); Springiness = ability of sample to recover to its original shape after the deforming force was removed; Gumminess (g) = force to disintegrate a semisolid meat sample for swallowing (hardness x cohesiveness) and Chewiness (g x mm) = work to masticate the sample for swallowing (springiness x gumminess), were determined as described by Bourne [12].

Lipid Oxidation

Lipid oxidation was assessed in triplicate by the 2-thiobarbituric acid (TBA) assays following the recommendations of Buege and Aust [13]. TBARS values were calculated from a standard curve of malonaldehyde (MAD) and expressed as mg MAD/kg sample.

Aerobic Plate Count

Chicken frankfurter sample (25 g) were excised from the interior of the sausages with a sterile scalpel and forceps. They were then homogeneized with sterile 1.5% peptone water in a Stomacher (Model 400, Colworth, London, UK) for 1.5 min, and serial dilutions were prepared, then 1 mL of each dilution was spread on a Petrifilm Aerobic Count Plate (3M, Microbiology Products, St. Paul, Minn., USA). After 48-h incubation at 35ºC, colonies were counted and results were expressed as log CFU/g of chicken frankfurters samples. Peptone water was from Oxoid (Oxoid Unipath Ltd. Basingtoke, Hampshire, UK). Three replicate trials were carried out for each sample.

Sensory Evaluation

Experienced panellists were recruited from the staff and students of the Miguel Hernández University, Alicante, Spain. Panellists were chosen on the basis of previous experience in consuming chicken frankfurters. Furthermore, a preparatory session was held prior to testing, so that each panel could thoroughly discuss and clarify each attribute to be evaluated in chicken frankfurters. Testing was initiated after the panellist agreed on the specifications. A Quantitative Descriptive Analysis was carried out [14]. All sensory work was carried out in the sensory laboratory at the Escuela Politécnica Superior de Orihuela (Universidad Miguel Hernández, Orihuela, Alicante, Spain), which fulfils requirements according to the international standards [15]. During evaluation the panellists were situated in private booths under incandescent/fluorescent light, with an intensity of approximately 350 lux. Sausages were taken out from the package, tempered to about 20°C and cut into 2-cm-long slices. These slices were distributed in white plates and presented to the panellist in random order for evaluation. Water and unsalted bread were provided to cleanse the palate between samples. The sensory attributes were measured in unstructured scales with descriptors at both ends, no standards were provided. The attributes measured and their descriptors were as follows: for global appearance (from 'unexpected chicken frankfurter appearance' to 'conventional chicken frankfurter appearance'), color intensity (from extremely light to extremely dark), pinkness (from pale pink to dark brown) and brightness (from extremely dull to extremely bright); flavour (from imperceptible plain flavour to extremely intense flavour perception); "off-odor perception" (from imperceptible to extremely intense). For "taste": acidity, saltiness and spiciness

(from imperceptible to extremely intense). For "texture and mouth feel": hardness (from extremely soft to extremely tough), compactness (from crumbly to compact), and juiciness (from extremely dry to extremely moist). At the end of the test, panellists were asked to give a score for overall quality of the product from 0 to 10.

Statistical Analysis

All data were expressed as means ± standard deviations (SD) of replicated determinations. The number of CFU/g was transformed to $\log_{10}$ for statistical analysis. Data from proximate composition, physicochemical analysis, lipid oxidation and microbial counts were analysed for formula and day effects by means of ANOVA test. Data from sensory characterization were also analysed by means of ANOVA test but the model included the formula, the assessor and the session nested to the assessor as fixed effects. The interaction assessor x formula was tested and dropped from the model since it was not significant (p>0.05). Comparisons between means were analyzed by least significance difference (p<0.05). Statistical analysis and comparison among means were performed using the statistical package SPSS 16.0 (SPSS Inc., Chicago, IL).

RESULTS AND DISCUSSION

Proximate Composition

Table **1** shows the average value and the standard deviation for the proximate composition of the four chicken frankfurter formula. Control and smoked frankfurters showed similar (p>0.05) proximate composition. Total protein and ash content were also similar (p>0.05) for all chicken frankfurter formula. Differences for proximate composition were only found (p<0.05) for moisture and crude fat content between frankfurters with or without WME. Frankfurters containing WME showed higher moisture and lower crude fat content (without differences between the two concentrations) than others (control and smoked frankfurters). In this case, the fat reduction was accompanied by an increase in moisture content. This effect upon fat and moisture content was also reported by Nassu *et al*. [16] in fermented goat meat sausage with rosemary extract added. This can be attributed to the fact that the addition of these extracts increases the water retention in the meat product.

González-Viñas *et al*. [17] evaluated different commercially available frankfurter and all of them showed a fat/protein ratio between 0.67 and 1.97. As can be seen in Table **1**, all our frankfurters are in this range. Matulis *et al*. [18] produced a predictive method to determine which composition factors determine the acceptance of frankfurter sausages, arriving at the conclusion that one of the most important factors is the fat content which must be higher than 11.25%. Also in this case, all our formula agrees with this parameter.

Physico-Chemical Analysis

Water activity and pH of chicken frankfurters were not affected (p>0.05) by formula or storage time. Although the water extracts showed an acidic pH (4.55±0.02), it didn't affect the pH of the frankfurters, may be due to the buffering capacity of meat proteins. Frankfurters showed a pH of 5.85±0.05 and a water activity of 0.97±0.03. Both values are in the range reported for conventional chicken frankfurters [17, 19]. In an emulsion system, a pH value lower than 5.6 may cause protein denaturation and/or loss of functionality, it can also break the emulsion, with consequent gelatine and fat separation.

Changes in CIELAB coordinates throughout the storage period of the 4 chicken frankfurters formula are shown in Figure **2**. All color coordinates were significantly (p<0.05) affected by the formula. Control and smoked frankfurters showed similar (p>0.05) lightness (L*), redness (a*) and yellowness (b*).

Table 1: Proximate Composition (g/100g) of Chicken Frankfurter

Formulation	Moisture	Total Protein	Crude Fat	Ash
Control	66.10±1.23[b]	17.88±0.99[a]	29.71±1.33[a]	2.18±0.22[a]
Smoked	65.93±1.85[b]	17.84±1.10[a]	29.71±1.03[a]	2.20±0.12[a]
0.25% WME	69.21±1.50[a]	18.01±1.20[a]	22.04±2.01[b]	2.14±0.15[a]
0.50% WME	69.31±1.11[a]	18.96±0.89[a]	20.961.96[b]	2.18±0.14[a]

WME: *M. communis* water extract.
[a-b]Means with different letters in the same column are significantly different (P<0.05) by Tuckey test.

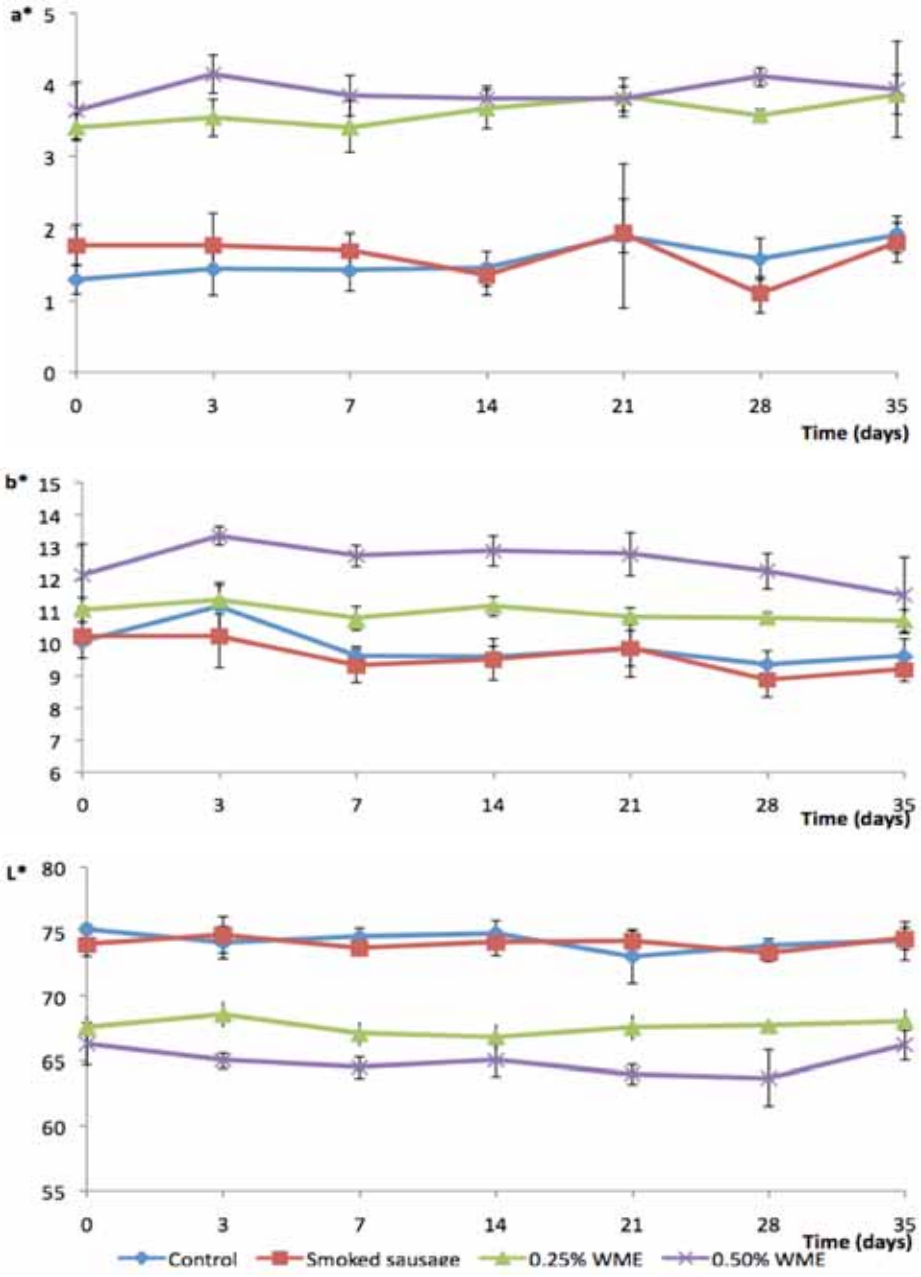

Figure 2: Color coordinates (Lightness (L*), redness (a*) and yellowness (b*)) of vacuum-packed chicken frankfurters: control, smoked and containing *Myrtus communis* extracts (WME), stored at 4 ºC for 35 days.

The addition of WME to frankfurters increased a* and b* values and decreased L* values. These changes in color coordinates were higher (p<0.05) when WME was added at higher concentrations, except for a* coordinate which was not affected by WME concentration. The increase in a* and b* values of chicken frankfurters by WME addition could indicate that *M. comunnis* extract can acts as a colorant. This colorant effect attributed to WME could be due to the presence of colorant compounds in the extract (chlorophyll and carotenoids) or to its antioxidant effect [7, 9]. Several authors have also reported that the addition of some additives as colorants (carotenes, xantofiles, anthocians, etc) in meat products (dry-cured, fresh, cooked or emulsions) decrease lightness [20].

For all formula, L* and a* values didn't change (p>0.05) during storage time, while b* values showed a slightly decrease (p<0.05). Some authors reported that L* is related to superficial free water, water vapor exchanges between the product and the environment and the modifications of the different states of hemopigments [21]. These modifications of the different states of hemopigments have also been

related to changes in a* and L* values. The high protection against the cited factors achieved by the film used for vacuum packaging could be responsible for the absence of modifications in L* and a* values. This behaviour of L* and a* values in vacuum-packed frankfurter during the refrigerated storage period has been also reported by other authors [19]. The evolution of b* values in chicken frankfurters during storage depended of the formula. Yellowness decreased (slightly) during storage in control and smoked frankfurter but it didn't change in frankfurters with WME. In this case, the antioxidant effect of WME could be protecting the compounds responsible of the yellow component of color.

The behaviour of color coordinates of chicken frankfurters with WME could indicate that the WME could be used as colorant for the meat industry, which is very interesting because it is of natural origin. Natural colorants have become increasingly popular among consumers because synthetic colorants tend to be perceived as undesirable and harmful; some are considered to be responsible for allergenic and intolerance reactions [22].

In the Texture Profile Analysis, no differences (p>0.05) in cohesiveness, adhesiveness and springiness were observed between frankfurters with WME added and without it (control and smoked samples). However, the samples containing WME (at both concentrations) had lower (p<0.05) hardness and chewiness than samples without WME (control and smoked frankfurters) (Figure **3**). This reduction may be due to the effect of chemical composition of myrtle extract that can increase emulsion stability through their protective role on proteins against oxidation. These results are in agreement with those reported in previous studies in which the addition of plant extracts

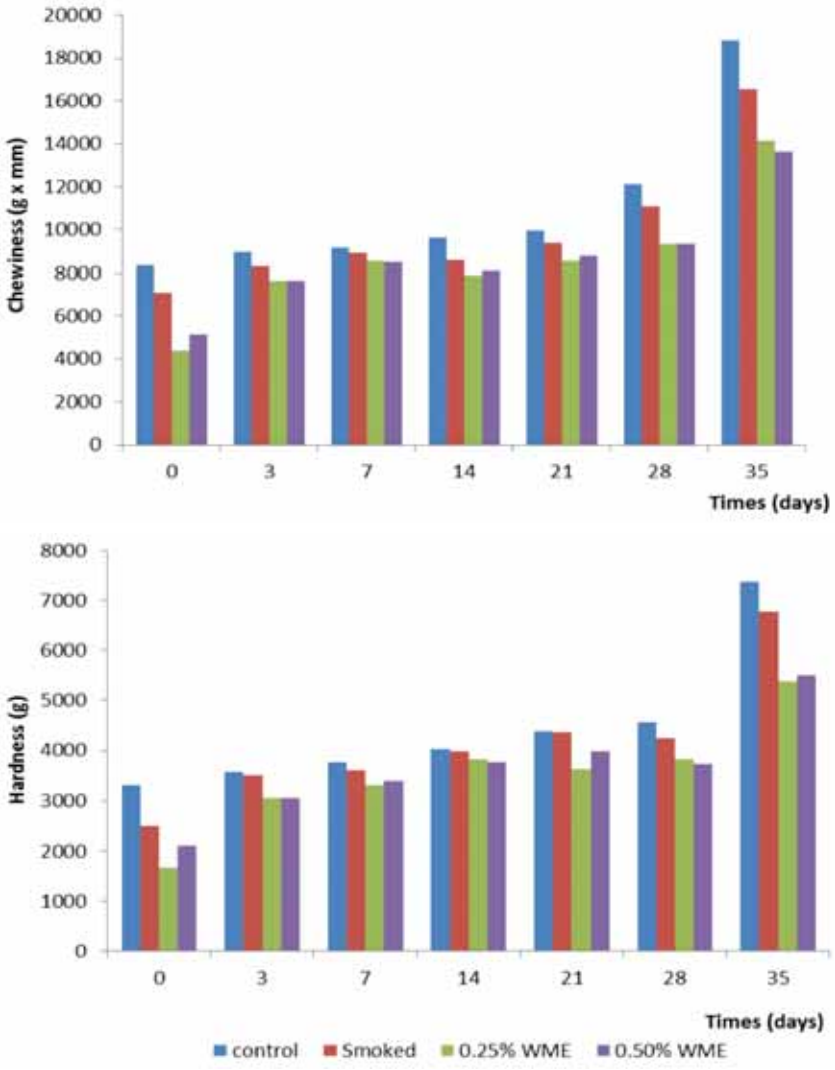

Figure 3: Hardness and chewiness (TPA parameters) of vacuum-packed chicken frankfurters: control, smoked andcontaining *Myrtus communis* extracts (WME), stored at 4 ºC for 35 days.

enhanced stability of meat and fat emulsions [23]. Cohesiveness and springiness of frankfurters didn't show differences (p>0.05) due to storage time. All samples showed cohesiveness's mean values of 0.52±0.06 and springiness's mean values of 4.45±0.05. However, all samples increased (p<0.05) hardness and chewiness during storage (Figure **3**). Hardness increase during refrigerated storage of meat emulsions has been previously described and was related to the process of emulsion destabilization due to water and fat separation from the protein matrix [23].

Lipid Oxidation

TBA test is one of the most widely used tests for evaluating the extent of lipid oxidation in meat products during storage [1, 2, 4]. Figure **4** shows the evolution of TBA values of chicken frankfurters during refrigerated storage. In general, samples with WME showed lower (p<0.05) TBA values than control and smoked samples. There was an increase in TBA values during storage time for samples without WME, however when the WME was added (at 0.25 and 0.50%) the TBA values remained stable (p>0.05) during the 35 days of refrigerated storage. It is important to remark that in spite of the increase in TBA values showed in chicken frankfurters without WME, the TBA values of all samples remained relatively low (less than 0.45 mg MA/kg sample), suggesting that there was little oxidative rancidity problems in these chicken meat products. And also, it is important to remark that the higher increase in TBA values occurred from day 43, because until then, the TBA values of all samples were lower than 0.26 mg MA/kg sample. Low TBA values in vacuum-packed chicken frankfurters during 30 days of refrigerated storage have been also reported by Jeun-Horng *et al*. [24]. They reported TBA values of 0.22 mg MA/kg in control samples at day 30, which is very similar to our values (Figure **4**). These authors suggested that the relatively low extent of lipid oxidation probably was due to the antioxidative activity of the nitrite added in chicken frankfurters and low oxygen concentration remaining in vacuum packaging (a low redox potential created). The WME addition in chicken frankfurters could prolong the antioxidative effect along the storage period and so TBA values in these samples didn't increase during storage. The antioxidant properties of different natural plant extracts have been determined in several poultry meat products such as raw and cooked chicken breast meat patties [25], pre-cooked chicken meatballs [26], cooked turkey meat [27] and cooked turkey meatballs [1].

These results suggest that the tested myrtle leaves extract protect the chicken frankfurters from oxidative deterioration. These effects may be associated with the presence of some compounds with antioxidant properties in the myrtle leaves extract assayed. In fact, *Myrtus* water extract is rich in phenolic compounds which have important antioxidant activities [7, 8, 10].

Aerobic Plate Count

Antimicrobial effects of *Myrtus* extracts in chicken frankfurters stored at 4 ºC are reflected in Figure **5**. During the first three weeks of storage, the aerobic

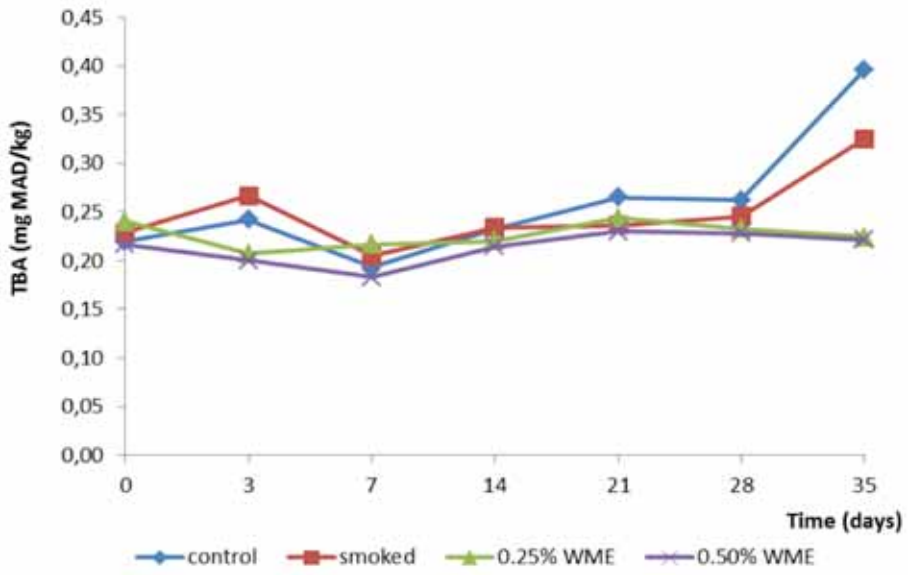

Figure 4: TBA values of vacuum-packed chicken frankfurters: control, smoked and containing *Myrtus communis* extracts (WME), stored at 4 ºC for 35 days.

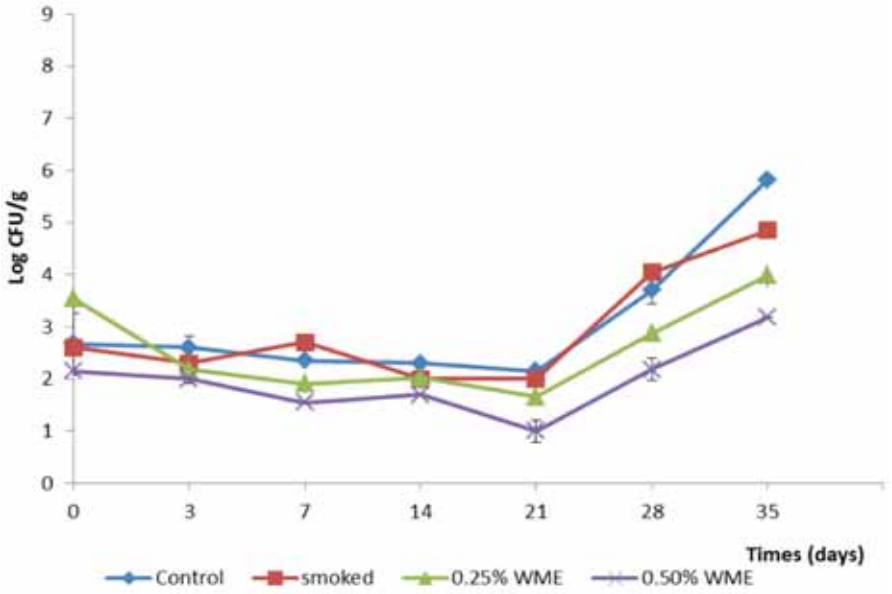

Figure 5: Aerobic plate count (log CFU/g) of vacuum-packed chicken frankfurters: control, smoked and containing *Myrtus communis* extracts (WME), stored at 4 ºC for 35 days.

plate counts (APC) in all sausage formulations remained below 4 log CFU/g which is in accordance with the performance of APC when Good Manufacturing Practice are followed, according to the recommendations of The International Commission on Microbiological Specifications for Foods (ICMSF) [28]. These results are in accordance with APC counts reported by Klavdija *et al*. [29], who also reported that the APC in vacuum-packed chicken frankfurters remained below 4 log CFU/g over 21-days of refrigerated (4 ºC) storage. The growth rate of bacteria affected by low temperatures, and most mesophilic bacteria will survive but will not grow at refrigerated temperatures.

At 35 days of storage, APC in frankfurters containing 0.25% and 0.5% WME were low (3.89 and 3.18 log CFU/g, respectively), whereas APC of control and smoked frankfurters were of 5.81 and 4.85 log CFU/g, respectively, and increased to reach 8.66 and 8.20 log CFU/g respectively at 42 days of storage. Control and smoked frankfurters were over the Maximal Permissible Limit for APC recommended by ICMSF [28] that is of 7 log CFU/g. *Myrtus* extract antimicrobial effect was concentration dependent: APC of 0.5% MWE sausages was significantly lower (3.00 log CFU/g) than that of 0.25% MWE added chicken frankfurters (4.56 log CFU/g). These results indicate that water extract of *M. communis* posses a strong antibacterial activity in this food.

Several researchers have reported that some medicinal plants and derived essential oils and extracts, retard or inhibit the growth of bacteria, yeast, and molds [5, 19]. So, they may inhibit the growth of food-borne pathogens in food products [8]. Klavdija *et al*. [29] reported that rosemary preparations possess antimicrobial properties in vacuum-packed chicken frankfurters. Several researchers have reported that phenolic compounds are the major responsible for the antibacterial behaviour of such plants. In previous papers, we reported that water extract from myrtle contain significantly high amount of total phenolic compounds [7] and most of *Myrtus communis* extracts show relatively high antibacterial activity against most of the tested microorganisms [8]. Myrtle leaves contain different polyphenolic classes as previously described by Romani *et al*. [9] that may be responsible of the anti-microbial effect of the extracts.

Sensory Analysis

Figure **6** shows the results obtained for the sensory evaluation of chicken frankfurters carried out at the beginning of the assay (day 0). None of the attributes selected to evaluate the taste (acidity, saltiness and spiciness) of the chicken frankfurters were affected (p>0.05) by WME or smoke addition. Smoked frankfurters were evaluated as having higher flavour intensity than control and WME added samples, which was attributed to the smoke odour. Panellist detected higher (p<0.05) off-odour in samples with WME added (highest for highest WME addition) than in control or smoked samples. These off-odour were mainly defined by the panellist as an unknown spice odour. This

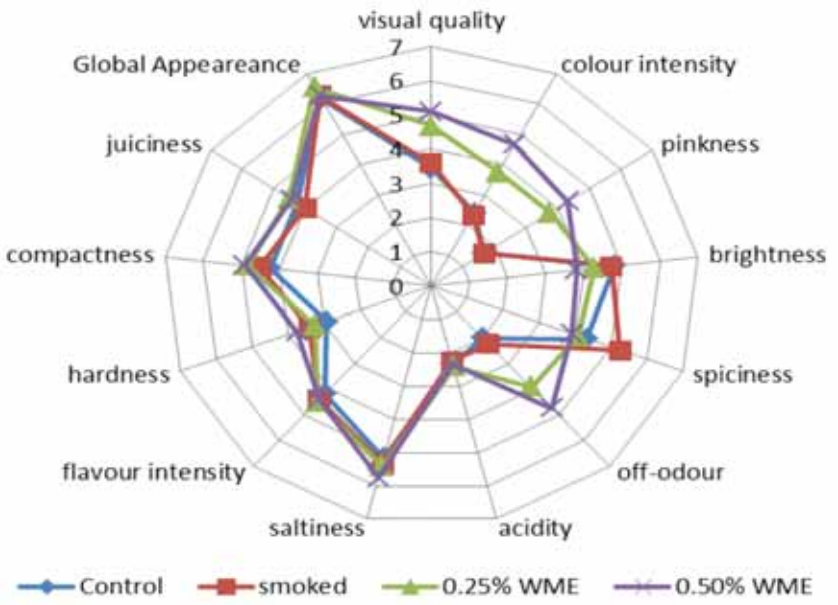

Figure 6: Results of sensorial analysis (QDA) of vacuum-packed chicken frankfurters: control, smoked and containing *Myrtus communis* extracts (WME).

increase in off-odour perception attributed to the odour of the added spice (rosemary, oregano, thymus, etc) has also been reported by several authors, and in all cases it was concentration dependent [4, 6]. WME addition modified the odour, but not the taste, as all sausages contained a mixture of spices (black pepper, mace, coriander, ginger**,** cardamom and garlic powder) which provided a quite uniform spice taste, and would have masked the taste of myrtle. So, the odor of WME containing sausages was perceived as different, but not the taste.

All attributes selected to evaluate visual perception were affected (p<0.05) by the addition of WME, however no differences (p>0.05) were found between control and smoked samples. The addition of WME increased the perception of color intensity, pinkness and global appearance and decreased the perception of brightness. These changes were also WME-concentration dependent. These results are in agreement with results of color instrumental measures. The decrease in lightness (Figure **2**) in samples with WME added is perceived by the panelists as a decrease in brightness and the increase in the a* coordinate is perceived as an increase in pinkness and color intensity. It is important to remark that the addition of WME increased the perception of the frankfurter overall quality, because this it is a highly relevant factor for consumers buying decisions.

From the three attributes selected to evaluate texture and mouth feel, only juiciness was not affected (p>0.05) by the addition of WME. The perception of hardness and compactness increased (p<0.05) when the extract was added, independently of the concentration. In this case there is no correlation between the hardness instrumental measure and sensory evaluation. Instrumental measure detected control frankfurters as the hardest but the panelists scored them as the softest. González-Viñas *et al*. [17] evaluated the physico-chemical, rheological and sensory characteristics of commercially available Spanish frankfurters and also reported that the grouping of the samples according to their sensory characteristics was not the same that the grouping obtained evaluating the chemical and phsysico-chemical variables. These results agree with those obtained by other authors when evaluating the acceptability of commercial sausages in the United States [30].

All frankfurters were highly scored for global appearance (6.18-6.54) without differences (p>0.05) between them.

CONCLUSIONS

Water myrtle extracts (0.25-0.50%) provide antioxidant and antimicrobial benefits to vacuum-packed chicken frankfurter during storage without cause evident sensorial changes. The effect of water myrtle extracts on colour coordinates in chicken frankfurters could indicate that these extracts may be use as natural colorants in this type of products. In

general, the application of natural myrtle extracts that posses both antioxidant and antimicrobial activities in meat products may be promising and useful for prolonging their shelf-life.

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