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Production of frankfurters with tomato powder as a natural additive

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ABSTRACT

This study includes the investigation of chemical properties such as nitrosomyoglobin content, lycopene content, and the oxidation level, and the sensorial properties of frankfurters which have been produced by both reducing the nitrite level and adding tomato powder. All samples have been vacuum packed and stored at +4 °C for 60 days.

The pH of the frankfurters produced with tomato powder was reduced, when compared to the samples which did not contain tomato powder. This effect was due to the acidic characteristics of tomato. As the level of nitrite was reduced, the oxidation level of the frankfurters was increased significantly. Addition of 2 g/100 g of tomato powder decreased the level of oxidation; however, 4 g/100 g of tomato powder caused a slight increase when compared to the samples which did not contain tomato powder. According to this result it can be stated that tomato powder retards the oxidation reaction. According to sensorial evaluations, tomato powder improved the consumer acceptability as well. Addition of tomato powder increased the internal and external colour scores, and frankfurters were found to be more acceptable by the panellists. Nitrosomyoglobin (NOMb) content of the samples was decreased along with the decreased level of nitrite, and this, in turn, contributed to the decreased level of redness (a*).

1. Introduction

The primary quality parameters of meat and meat products for consumers are colour, appearance and texture (Oztan, 2005; p 495). The colour is the first major impression on consumers during the selection of food products (Deda, Bloukas, & Fista, 2007). Meat and meat products tend to discolour at the initial stages of the storage and to prevent the discolouration of meat products, nitrites are used as curing agents. Nitrites used for curing of meat have the following main functions which are i. protection against to food poisoning bacteria such as *Clostrodium botulinum*, ii. Giving a characteristic flavour to cured meat products, iii. Giving a characteristic colour to meat products by the conversion of nitrite with myoglobin to nitrosomyloglobin iv. Having an antioxidant activity (Deda et al., 2007; Østerlie & Lerfall, 2005). Although nitrite has very important functions in cured meat products, it is a toxic additive which has very strict usage rules. Because of the toxic effects of nitrite, studies on the production of meat products with reduced nitrite levels have been increased (Deda et al., 2007; Østerlie, 2005). To replace the use of nitrite mostly natural additives are preferred due to consumer preferences (Østerlie, 2005). Natural additives are believed to be healthy and are of good quality. Lycopene is the most studied natural additive recently.

Lycopene is one of the carotenoids found in nature and it gives to tomatoes, watermelon, red grapefruit and red pepper, their characteristic red colour (Goula & Adamopoulos, 2005). Tomato and tomato products are the main source of lycopene, and the studies have shown that the increased consumption of tomatoes decrease the risk of occurrence of cardiovascular diseases, and prostate, lung and digestive system cancers (Østerlie & Lerfall, 2005; Southon, 2000). Epidemiologic data on the relationship between cancer risk and the intake of lycopene from tomato and its products are available (Omoni & Aluko, 2005). Giovannucci et al. (1995) studied 46 different fruits and vegetables and their effects on the rate of prostate cancer on approximately 48,000 men for 4 years. Among these 46 fruits and vegetables, only four were significantly associated with the lower prostate cancer risk. From 4 of these fruits and vegetables, tomato sauce, tomatoes and pizza sauce (not strawberries) were the primary source of lycopene. They also reported that if a man consumes 10 or more servings per week of tomato products, he is less likely to develop prostate cancer with a rate of 34%. It was also found by Gann et al. (1999) that lycopene was the only antioxidant that occurred at a significantly lower level in men who developed prostate cancer when compared to status-matched controls.

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Kuopio Ischemic Heart Disease Risk Facor (KIHD) study shows that the thickness of the innermost wall of blood vessels and the risk of myocardial infarction are reduced with higher serum and adipose tissue concentration of lycopene (Rissanen, Voutilainen, Salonen, Kaplan, & Salonen, 2003). According to this result, it is suggested that the serum level of lycopene probably plays a role in the early stages of artherosclerosis (Omoni & Aluko, 2005).

The protective effect of tomatoes is related to the lycopene content. Although lycopene has no provitamin A activity, it has an antioxidant activity, and it quenches the singlet oxygen. The quenching effect is found to be double than that of β-carotene and 10 times more than α-tocopherol (Shi, Le Maguer, Kakuda, Liptay, & Niekamp, 1999). Lycopene is an acyclic open chain unsaturated carotenoid having 13 double bonds, and 11 of them are conjugated. It is believed that the colour and antioxidant activity of lycopene are results of its unique structure (Shi & Le Maguer, 2000).

Many studies have been performed on the usage of tomato and tomato products. Yılmaz, Şimşek, and Işıklı (2002) have reported the usage of tomato juice in low-fat cooked sausages, Candogan (2002) has reported the usage of tomato paste in beef patties, Østerlie and Lerfall (2005) have studied the effect of lycopene in tomato products on storage quality of minced meat. Sánchez-Escalante, Torrescano, Djenane, Beltran, and Roncales (2003) have studied on the stabilization of colour and odour of beef patties with lycopene rich tomato and peppers and Calvo, Garcia, and Selgas (2008) have reported the effects of tomato peel in dry fermented sausages. Only a few results have been reported on the reduced level of nitrite and usage of tomato products (Deda et al., 2007).

The objective of this study was to evaluate the effect of tomato powder and sodium nitrite levels on processing and quality characteristics of frankfurters during their two months of storage under vacuum. Generally a synthetic colorant is used in the production of frankfurters found in the market. In this study no synthetic colouring agent was used in order to show the effect of tomato powder alone on colour and other properties of the frankfurters.

2. Materials and methods

2.1. Chemicals and ingredients

Sun dried tomato powder having a moisture content of 11.38 g/100 g and a pH between 4.82 and 5.02 (in distilled water) was obtained from GMT Ingredients Co. (Istanbul, Turkey). Meat and ingredients used for the production of frankfurters were obtained from Guney Gida Lezz'et Industry (Antalya, Turkey). Lycopene standard was obtained from Sigma–Aldrich (product no: L9879-1 MG, Germany). Chemicals used for extraction processes were obtained from Ildam Kimya Co. (Ankara, Turkey).

2.2. Production of frankfurters

The following raw materials and ingredients were used for each treatment. Beef meat (with low trimming and 15 g/100 g fat) 4.8 kg, fat (beef fat) 1 kg, ice 1.2 kg, sodium chloride (NaCl) 0.105 kg, natrium-phosphate 0.040 kg and starch 0.380 kg. Nine different treatments of frankfurters were prepared and studied with 3 nitrite levels (150, 100, 50 mg/kg of mixture) and 3 tomato powder levels (0, 2, 4 g/100 g of mixture). The amounts in the samples are as follows: 150 mg/kg nitrite only (Sample 1), 150 mg/kg nitrite and 2 g/100 g of tomato powder (T.P) (Sample 2), 150 mg/kg nitrite and 4 g/100 g of T.P (sample 3), 100 mg/kg nitrite only (Sample 4), 100 mg/kg nitrite and 2 g/100 g mixture of T.P (Sample 5), 100 mg/kg nitrite and 4 g/100 g of T.P (sample 6), 50 mg/kg nitrite only (Sample 7), 50 mg/kg nitrite and 2 g/100 g of tomato powder (T.P) (Sample 8), 50 mg/kg nitrite and 4 g/100 g of T.P (sample 9). Synthetic coloring agents were not used in the samples. The production of the frankfurters was performed at the LEZZ'ET Industry (Antalya) according to their original production recipe. Meat farce at a temperature of −12 °C, half of the fat, and the ice were all added to the cutter (MADO, Adjutant MTK 661, Germany) which is used for research and development (R&D) purposes. The cutter was started at a low speed (1400 rpm blade speed), and then the ingredients and the rest of the ice were added. After these additions, the cutter was set to work at high speed (2800 rpm blade speed), till the temperature of the mixture reached to 12–14 °C. The mixture was stuffed into 18 Ø (calibre) synthetic casings. The frankfurters' casings were linked at 15 cm intervals and processed in the combined oven (including drying, cooking and smoking parts in it). The processing conditions in the oven was as follows pre-heating at 55 °C 10 min at 70–75% relative humidity (RH), 1st drying 58 °C for 25 min at 30% RH, smoking 58 °C 12 min at 60–70% RH, 2nd drying 60 °C 10 min at 20–30% RH, smoking 62 °C 15 min at 20–30% RH, 3rd drying 62 °C 5 min at 20–30% RH and heat processing at 100% RH to an internal temperature of 72 °C. The frankfurters were then rinsed for cooling with cooling water at 5 °C. After cooling, the casings were peeled and frankfurters were vacuum packed. Each pack contained 4 frankfurters. After cooling, the frankfurters were re-pasteurized at 85 °C for 20 min and cooled. The vacuum packed frankfurters were stored at +4 °C for 60 days. Analyses were performed at the 1st, 7th, 14th, 30th, 45th and 60 days. 3 replications were performed and each test was applied for each replication.

2.3. Colour measurements

Colour measurements including redness (a*), yellowness (b*) and lightness (L*) of the samples were performed by using Minolta Chromameter (Model CM 3600 d; Osaka Japan). Measurements were taken from the inner cuts of the frankfurters and repeated 4 times for every sample. The hue of the samples were calculated with the equation of $H = \tan^{-1}(a^*/b^*)$. Measurements were performed in 3 parallels.

2.4. pH measurement

10 g of sample was weighted and homogenized with Virtis homogenizer (The Virtis Co. Gardiner NY) at 5000rpm, after adding 50 ml of distilled water. After filtering the homogenate through a filter paper, the pH was measured by using Inolab 12217 Digital pH-meter (Weilheim, Germany). The analyses were performed in 3 parallels.

2.5. Determination of NOMb content

Method of Hornsey (1956) was used for the determination of NOMb content in samples. Cured pigment analysis and total pigment analysis were performed. Nitroso–pigments were extracted by using a mixture of acetone and water. Hydrochloric acid was used for the extraction of total pigments from the meat product. The amount of nitrosomyoglobin in frankfurters could be calculated from the results of nitroso-pigment and total pigment analysis. Three parallels were tested for each sample.

2.5.1. Nitroso– pigment analysis

10 g of samples were weighed and placed in brown bottles. 40 ml of acetone and 3 ml of distilled water were added and stirred for 5 min. The mixture was filtered through a rough filter paper and absorbances were obtained at 540 nm against 40 ml of acetone and 3 ml of distilled water mixture. The amount of cured pigments (NOMb) was calculated by multiplying 290 with absorbance (A_1) read at 540 nm.