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Assessment of Quality Indices and Their Influence on the Texture Profile in the Dry-Aging Process of Beef

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Abstract: The aim of this study was to investigate the effects of the dry-aging method on the sensory properties, chemical composition, and profile parameters of the texture of beef obtained from local farms. The qualitative characteristics of the beef were investigated for five samples, respectively, fresh meat, and dry-aged beef for 14, 21, 28, and 35 days, in aging rooms with controlled parameters: temperature (1 ± 1 °C), relative humidity (80 ± 5%), and air circulation speed (0.5–2 m/s). During the dry-aging period, there was a decrease in humidity by about 6.5% in the first 21 days, which allowed the concentration of fat, protein, and total collagen content. The dry-aging process considerably influenced the pH value of the meat, which, in the second part of the dry-aging process (14–35 days), increased from 5.49 to 5.66. These values favored the increase by 37.33% of the water retention capacity and the activation of the meat's own enzymes (calpain, cathepsin, collagenase). This influenced the solubilization process of proteins and collagen, thus contributing to the improvement of the texture profile. Because variations in organoleptic and physicochemical parameters occurred simultaneously during dry-aging and storage, the method of analyzing the information was applied. Mutual information on the influence of physicochemical indicators on the texture profile parameters was followed, a factor of major importance in the consumer's perception. The degree of influence of soluble proteins, sarcoplasmic and myofibrillar proteins, fats, and soluble collagen content on the texture profile parameters (hardness, cohesiveness, springiness, gumminess, and chewiness) of the dry-aged beef for 35 days was established. These investigations allowed the optimization of the beef dry-aging technological process in order to obtain a product with a sensory profile preferred by the consumer.

Keywords: beef; aged meat; sensory and physicochemical indicators; texture parameters; information analysis

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1. Introduction

Meat has been and is an indispensable product of the human diet, both as a food in itself, and as an essential ingredient in many other foods, due to its chemical composition and valuable biological value [1–3]. According to the Organization for Economic Cooperation and Development (OECD), the world production of beef in 2021 increased by 4.8 million tons compared to the level of 2012, which amounted to 6.8%. The main counterparties in the beef market are the USA, Brazil, and China, which provide more than 40% of the world production [4]. The production of beef in the European Union countries over the past decade has slightly decreased by an average of 1.5%, and holds a more stable position, providing about 10% of the world beef production [5].

Meat is mostly the muscle tissue of an animal, with a complex chemical composition [6–8].

Beef has a protein content of between 26 and 31% [9,10], which is the main constituent of the structure of the meat product [9]. Actin and myosin (myofibrillar proteins) represent about 2%, soluble sarcoplasmic proteins constitute about 6, and 2% are the connective tissues—collagen and elastin, which cover the structural protein [11]. Collagen differs from most other proteins in that it contains the amino acids, hydroxylysine and hydroxyproline. Elastin, also present in connective tissue, has less hydroxylysine and hydroxyproline. Thus, the protein content of meat rich in connective tissue is lower than that of meat without connective tissue. The presence of connective tissue makes the product harder and with low nutritional and economic value [6].

Beef is appreciated for its important content of macronutrients in ensuring a healthy and balanced diet. The content of proteins, proteolytic enzymes together with the speed of muscle contraction (beef—slow contraction), and the type of metabolism (oxidative for beef) determine the variation of the muscle-type speed maturation. During the aging process, the meat's own enzymes contribute to the improvement of the meat's quality, achieving the tenderization of the meat by their action on the myofibrillar and sarcoplasmic system. Calpain and cathepsin mainly degrade myofibrillar proteins, resulting in increased soluble protein content. Some cathepsins (B, L, H) together with the multifunctional system enzymes (proteasome, prosome) weaken the connective tissue [12].

The beef industry is constantly looking for new ways to meet consumer demand for high-quality products. The taste of beef is described as a combination of three factors: tenderness, aroma, and juiciness, and the meat humidity has an important role in determining these factors. The combination of these factors allows the consumer to perceive the taste of the product [6,13–15].

In this context, in order to obtain high characteristics of tenderness, juiciness, and consistency, beef can be subjected to the ageing process. The aging of meat is defined as a process which naturally enhances the taste and tenderness of the whole carcass or its parts at refrigerated temperatures [16].

In general, there are two forms of beef-aging techniques: wet and dry, which result in flavor development and more tender meat. Dry- and wet-aging methods are widely applied for the aging of meat [17,18]. When beef is wet-aged, it is put in a vacuum-sealed package and stored in a controlled environment for a specific period of time, in vacuum packages at 1–3 °C for a couple of weeks. The length of treatment varies between 3 to 90 days [19].

Dry-aging is the process of placing the unpackaged beef carcasses in an aging room and leaving them to age for several weeks at controlled parameters [20,21]. The key effect of dry-aging is to concentrate the flavor that can only be described as "dry-aged beef" [17,22,23]. During the dry-aging process, the juices are absorbed into the meat, and the chemical breakdown of protein and fat constituents occurs, which results in a more intense nutty and beefy flavor. During aging, the beef's natural enzymes break down the proteins and connective tissue in the muscle, which leads to more tender beef [22,24,25]. The dry-aging process takes place in aging rooms with predetermined parameters: temperature (1–3 °C), and 70–85% humidity, for a minimum of 21–28 days on average, without the application of any protective packaging process. In this process, the unique aroma and tenderness occur due to enzymatic and biochemical changes in the meat [16].

There are different opinions in the industry about desirable flavor. Most people agree that dry-aging results in a unique flavor. However, people not familiar with dry-aged beef often describe it as slightly "musty" in flavor when eaten for the first time. The study of [26] showed that dry-aging resulted in a more intense beef flavor, more intense color, and less moisture content compared with aging "in the bag".

The aim of this research is to study the influence of the dry-aging process stages on the sensory, physicochemical, and texture indices of dry-aged beef.

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