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A COMPARATIVE ASSESSMENT OF THE RHEOLOGICAL PROPERTIES OF WILD BOAR AND DOMESTIC PORK MEAT

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Abstract:

The purpose of this work was to assess the rheological attributes of wild boar meat as a novel option for meat processing, against commercially produced pork. Uniaxial compression and stress relaxation tests were used to evaluate the rheological properties of wild boar and industrially farmed pork, with measurements taken both parallel and transverse to the muscle fiber direction. Compression testing revealed that the linear region of the stress-strain curves exhibited multiple linear phases with varying slopes, corresponding to substantial differences in compressive modulus. Analysis of the relaxation curve terminal phase revealed force differentials of 0.8 N (longitudinal compression) and 3 N (transverse compression) for wild boar meat. Domestic pork samples demonstrated superior consistency, displaying minimal variations of merely 0.2 N and 0.8 N for longitudinal and transverse compression, respectively. The final compression phase was significantly easier to achieve in wild boar meat for both longitudinal and perpendicular fiber orientations, which showed similar behavior. Domestic pork exhibited higher final compression modulus values than wild boar, with maximum values observed in perpendicularly sectioned muscle. The highest compression energy requirement was recorded for perpendicularly oriented domestic pork fibers, while the lowest corresponded to longitudinally sectioned wild boar meat. The rheological tests conducted provide clear evidence of the differential textural properties between domestic swine and wild boar muscular tissue.

Introduction:

The wild boar (*Sus scrofa*) is a species widely exploited for both human consumption and sport hunting across the globe. The recent increase in wild populations, combined with the species' potential for domestication and breeding, has sparked significant interest in its use as a source of meat. Compared to domestic pigs (*Sus scrofa domesticus*), wild boars exhibit several distinct characteristics, including a higher amount of adipose tissue in the carcass, a larger longissimus dorsi muscle area (located along the back and upper hind limbs), a greater proportion of slow-twitch oxidative muscle fibers, and an increased number of fast-twitch oxidative-glycolytic fibers. Conversely, the proportion of fast-twitch glycolytic fibers is reduced. Wild boar meat tends to have a darker color, and is generally leaner and less tender than that of domestic pigs.

Despite the marked differences in muscle fiber composition—which would be expected to significantly influence meat quality—the physical traits associated with these fiber types remain under-investigated. Although wild boar meat presents excellent potential for incorporation into processed meat products, few studies have assessed its processing characteristics or consumer acceptability in various prepared formulations.

Material and method:

Two samples were collected from the quadriceps femoris muscle of the wild boar and domestic pig. The initial phase of the process occurred in a refrigeration unit maintained at a temperature ranging from 6 to 8°C. Two hours prior to conducting the tests, the selected assortment was retrieved from the refrigerator and placed at the ambient temperature of the room to facilitate thermoregulation. In order to characterize the rheological properties of the two samples of meat, the uniaxial compression and tensile tests (stress) were performed in the longitudinal and horizontal directions on the fibers. The measurements were obtained at the ambient temperature of the chamber. The utilization of a univalent cylindrical device facilitated the extraction of cylindrical specimens from the flesh. The diameter of the probe was adjusted to 18 mm using a cutter, resulting in an adjusted length of 9–14 mm. The thickness of the samples was measured with an electronic caliper with a precision of 0.00 mm. All experimental measurements were conducted using the JTL Janz apparatus for compression.

Results and discussions

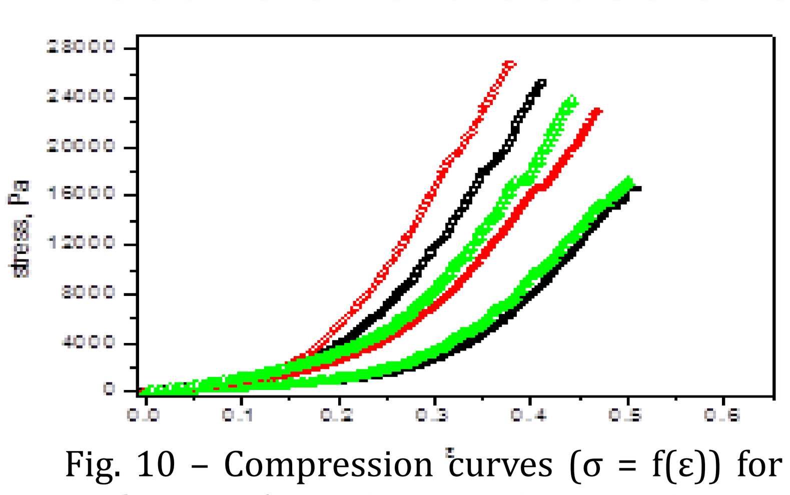

Fig. 10 – Compression curves (σ = f(ε)) for pork meat. (■ – P1L; □ – P1P; ● – P2L; ○ – P2P; ▲ – P3L; Δ – P3P)

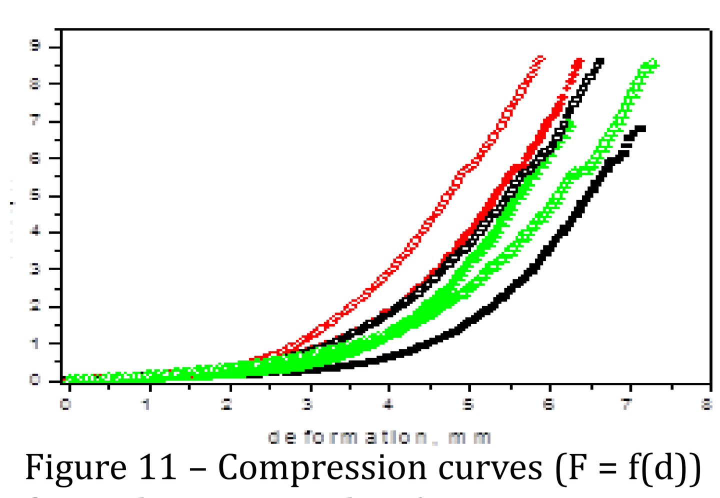

Figure 11 – Compression curves (F = f(d)) for pork meat samples. (■ – P1L; □ – P1P; ● – P2L; ○ – P2P; ▲ – P3L; Δ – P3P)

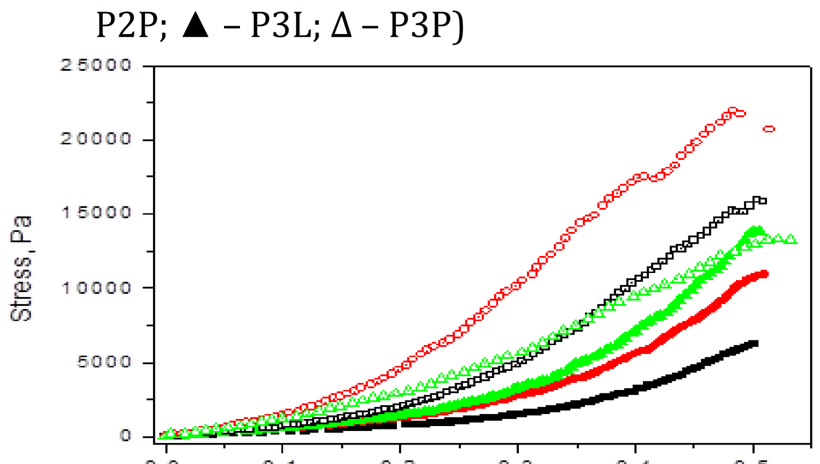

Figure 12 – Compression curves (σ = f(ε)) for wild boar meat samples. (■ – P1L; □ – P1P; ● – P2L; ○ – P2P; ▲ – P3L; Δ – P3P)

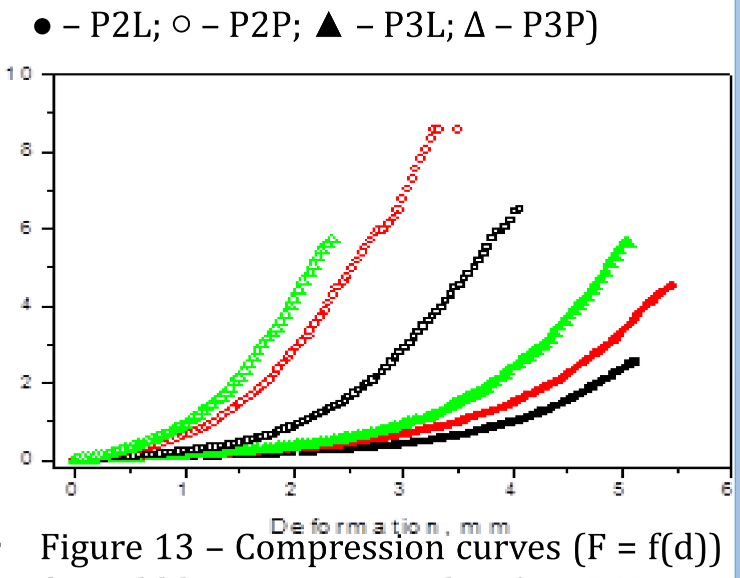

Figure 13 – Compression curves (F = f(d)) for wild boar meat samples. (■ – P1L; □ – P1P; ● – P2L; ○ – P2P; ▲ – P3L; Δ – P3P)

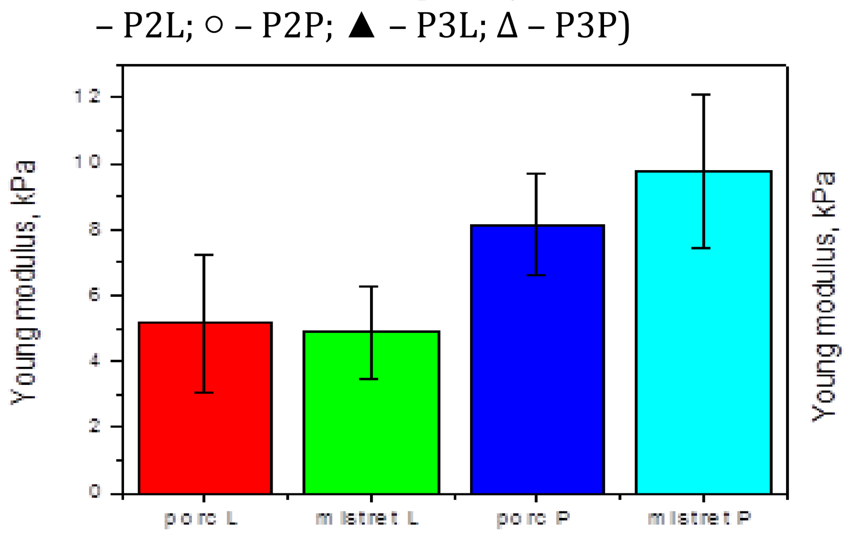

Figure 19 – Influence of meat type and compression direction (relative to the muscle fibers) on the initial compression modulus

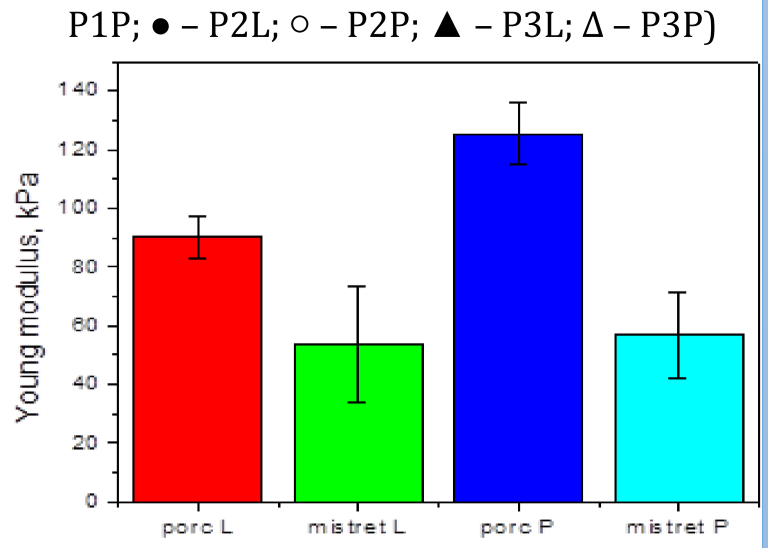

Figure 20 – Influence of meat type and compression direction (relative to the muscle fibers) on the final compression modulus

Conclusions:

Compression tests revealed the linear elastic characteristics of pork meat samples from domestic pigs (*Sus scrofa domesticus*) and wild boars (*Sus scrofa*). The deformation was limited to less than 20% of the initial sample height, and the compression modulus was calculated within this range. The relationship between the compression modulus and the energy required to achieve 20% deformation exhibited a highly linear correlation. The material properties derived from the interpretation of the compression curves clearly indicate textural differences between the two types of pork meat under investigation. Viscoelastic properties were assessed by performing stress relaxation tests following the application of 20% strain to the meat samples. For the purpose of mathematical modeling of the relaxation behavior, a three-element mechanical model was used. This model, schematically illustrated in Figure 1, consists of Maxwell elements arranged in parallel with an ideal spring.

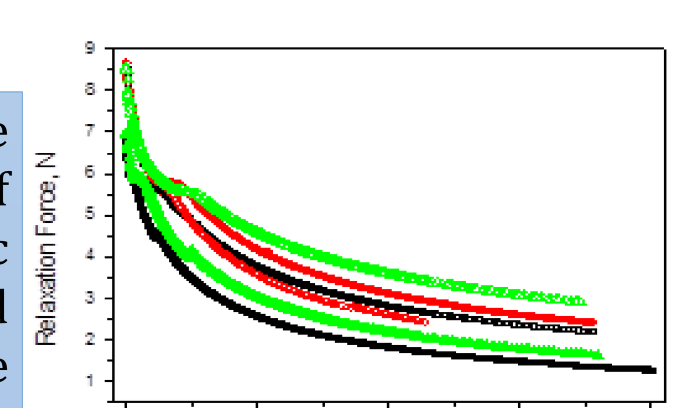

Figure 14 – Relaxation curves for pork meat samples. (■ – P1L; □ – P1P; ● – P2L; ○ – P2P; ▲ – P3L; Δ – P3P)

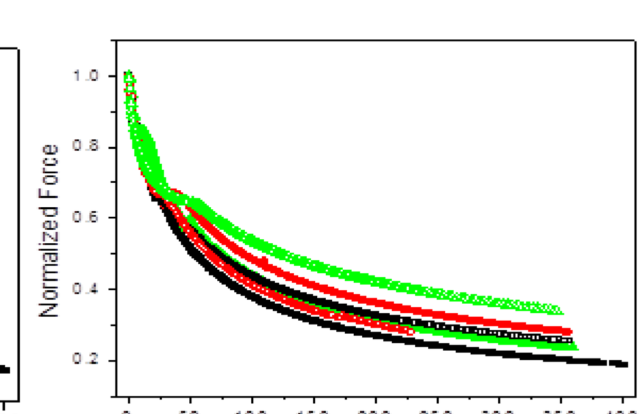

Figure 15 – Normalized relaxation curves for pork meat samples. (■ – P1L; □ – P1P; ● – P2L; ○ – P2P; ▲ – P3L; Δ – P3P)

Relaxation Tests

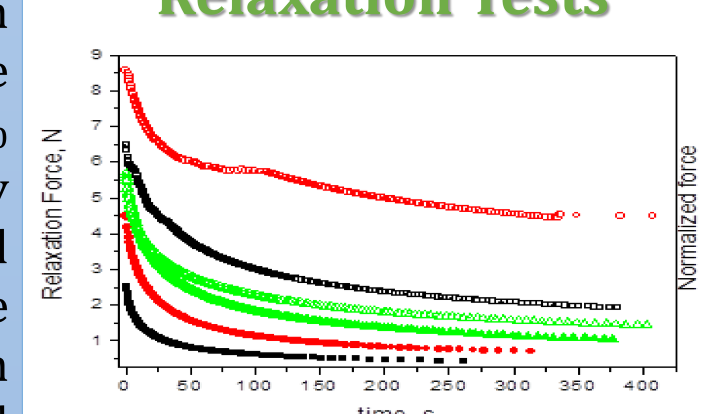

Figure 16 – Relaxation curves for wild boar meat samples. (■ – P1L; □ – P1P; ● – P2L; ○ – P2P; ▲ – P3L; Δ – P3P)

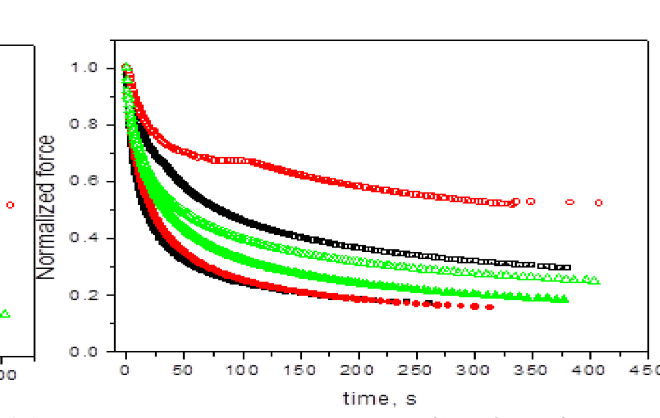

Figure 17 – Normalized relaxation curves for wild boar meat samples. (■ – P1L; □ – P1P; ● – P2L; ○ – P2P; ▲ – P3L; Δ – P3P)

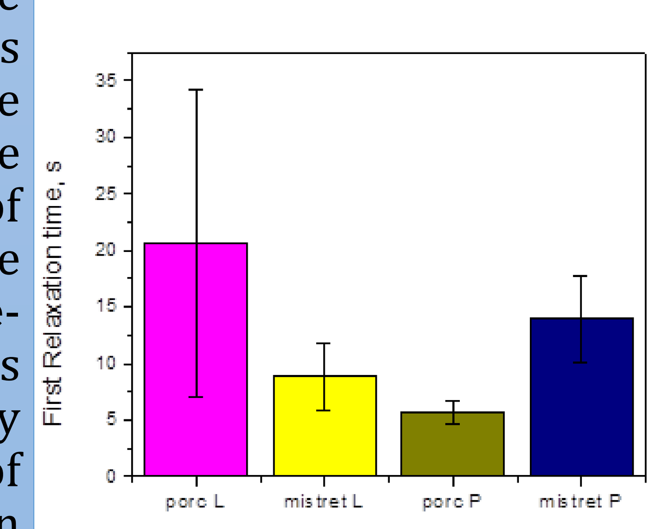

Figure 23 – Influence of meat type and compression direction (relative to the muscle fibers) on the first relaxation time

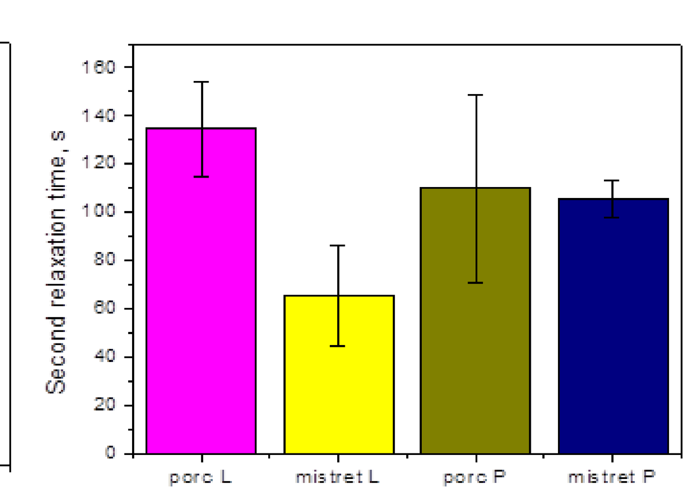

Figure 24 – Influence of meat type and compression direction (relative to the muscle fibers) on the second relaxation time

Keywords: pork, game, compression tests, stress relaxation tests