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ACTIVE MULTILAYER FILMS FOR STORING PORK LOINS

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I. INTRODUCTION

Food packaging plays a crucial role in maintaining food safety and quality, helping to minimize food waste in the process. Biopolymers like proteins and polysaccharides are gaining attention as sustainable alternatives for packaging materials due to their eco-friendly characteristics. One such polysaccharide is furcellaran—a negatively charged compound derived from the red seaweed *Furcellaria lumbricalis*. Due to its gel-forming abilities, furcellaran shows promise as a functional component in packaging applications. Additionally, it is non-toxic and compatible with other active substances, allowing their beneficial effects to remain unimpeded. Active packaging, which incorporates functional additives to prolong food shelf life, is becoming increasingly popular. This study aimed to utilize two previously characterized film types [1,2] as packaging solutions for a meat product.

II. MATERIALS AND METHODS

Preparation of active films

The preparation methods for FILM A and FILM B are described in publications [1] and [2], respectively, and both are illustrated in **Figure 1**.

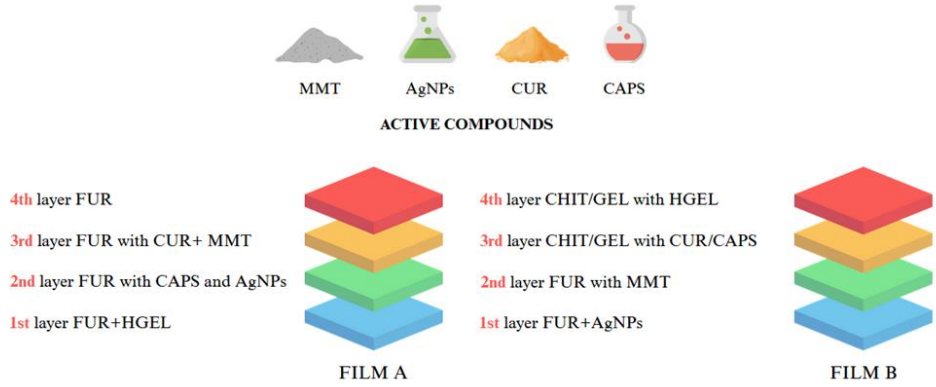


Figure 1. Schematic representation of the preparation of two film types used in the experimental study involving a food product.

Assessment of Film Impact on Pork Loin Quality During Refrigerated Storage

Pork loin slices were categorized into four treatment groups: wrapped in FILM A, wrapped in FILM B, wrapped in LDPE film (control), and unwrapped (control). All samples were sealed using a tray sealing machine and stored at 4°C for a period of 15 days. Evaluations were conducted on days 0, 4, 7, 11, and 15 to assess proximate composition and sensory attributes (color, aroma, texture, and overall acceptability) following the methodology described in reference [3]. The study was performed in three independent replicates. Statistical analysis involved two-way ANOVA followed by Tukey's post-hoc test, with significance set at $p < 0.05$.

III. RESULTS AND DISCUSSION

Table 1 presents the results of proximate composition analysis, including dry matter, fat, ash, and protein content in pork loin samples at day 0 and day 15 of refrigerated storage. Both FILM A and FILM B contributed to a marked increase in dry matter content, likely due to dehydration effects associated with the film materials. This was accompanied by an increase in fat and protein concentrations, which may be a consequence of water loss concentrating the remaining solid components. In particular, FILM B resulted in the highest values of dry matter (40.16 g/100 g) and protein (32.66 g/100 g), suggesting a stronger dehydrating effect compared to the other treatments. This could indicate limited moisture barrier properties of the tested films, especially when applied to high-moisture meat products. Furthermore, the slight increase in ash content may reflect minor mineral diffusion or concentration changes during storage.

Table 1 Proximate composition

	Dry weight [g/100 g]		Fat [g/100 g]		Ash [g/100 g]		Protein [g/100 g]	
	0 day	15 day	0 day	15 day	0 day	15 day	0	15 day
Control	$28.95^{b}\pm0.68$	$26.20^{a}\pm0.56$	$3.61^{ab}\pm1.09$	$2.37^{a}\pm0.53$	$1.28^{a}\pm0.05$	$1.43^{ab}\pm0.14$	$23.53^{a}\pm1.00$	$21.92^{a}\pm0.94$

LDPE	$28.95^{b}\pm0.68$	$26.78^{a}\pm0.31$	$3.61^{ab}\pm1.09$	$2.14^{a}\pm0.45$	$1.28^{a}\pm0.05$	$1.44^{ab}\pm0.10$	$23.53^{a}\pm1.00$	$22.55^{a}\pm1.42$
FILM B	$28.95^{b}\pm0.68$	$40.16^{d}\pm0.70$	$3.61^{ab}\pm1.09$	$4.70^{b}\pm1.55$	$1.28^{a}\pm0.05$	$1.50^{b}\pm0.09$	$23.53^{a}\pm1.00$	$32.66^{b}\pm1.24$
FILM A	$28.95^{b}\pm0.68$	$33.31^{c}\pm0.71$	$3.61^{ab}\pm1.09$	$4.48^{b}\pm0.98$	$1.28^{a}\pm0.05$	$1.47^{b}\pm0.12$	$23.53^{a}\pm1.00$	$26.07^{b}\pm1.82$

During the entire storage period, the control samples consistently received higher sensory ratings across all evaluated attributes compared to the treated samples (**Figure 2**).

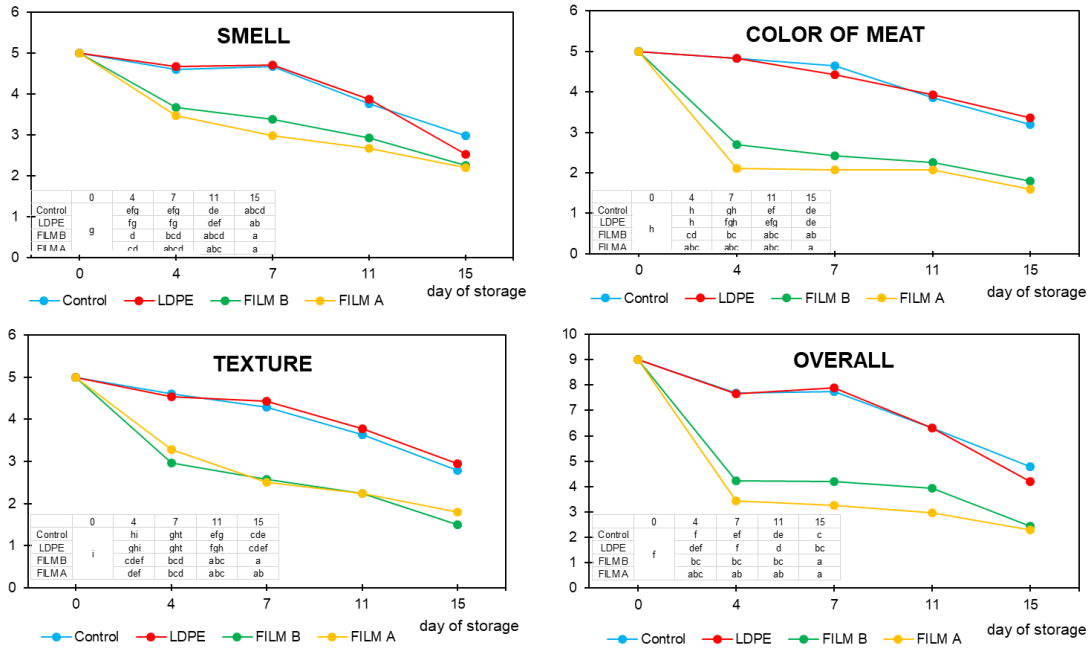


Figure 1. Sensory scores of pork loin samples in wrapped films stored at 4°C.

The samples wrapped in the developed films were found to be unacceptable in terms of color and overall acceptability as early as day 4, while texture deteriorated significantly by day 7, and aroma was no longer acceptable after 15 days. In contrast, both control samples maintained acceptable quality across all these parameters up to the 15th day of storage. Notably, all the tested films not only contributed to meat dehydration but also caused discoloration, with the meat adopting hues influenced by the active compounds present in the films.

IV. CONCLUSION

Active films were obtained and used as packaging materials for pork loins. During storage, an increase in fat and protein concentrations was noticed, which may be a consequence of water loss. FILM A and FILM B negatively impacted the sensory qualities of the product, making them unsuitable for use with items that have a high water content. It is necessary to use the obtained films as packaging materials for dried meat products.

ACKNOWLEDGEMENTS

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