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QUALITY OF CHUB-PACKAGED FRESH PORK SAUSAGE DURING REFRIGERATED DISPLAY

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Introduction

The United States Code of Federal Regulations describes fresh pork sausage as being prepared with fresh or frozen pork, seasonings and not more than 3% water or ice which may be added to facilitate chopping or mixing (CFR, 2003). The product is typically utilized as a breakfast item after pan or oven grilling. Three forms of stuffed fresh pork sausage predominate: chub-packaged, patties, or small diameter links. Marketing as tray packaged preformed patties and sausage links requires additional handling and display in non-barrier films which leads to shelf life expectations in the range of 14-21 days (Anon., 2004; Sebranek et al., 2004). Bulk packaged sausage in chub form of approximately 0.45 kg units are generally expected to have a longer display life due to less handling and use of casings with oxygen barrier properties.

Objectives

The purpose of this study was to evaluate oxidative, microbial, and sensory properties of chub-packaged fresh sausage quality during a 10-week display period at 4^{o}C.

Methodology

Three production lots of fresh pork sausage stuffed in 6.25 cm diameter casings and linked into 0.45 kg chub-style packages were each manufactured in a different week at a regional processing plant operating under USDA inspection. The chubs were blast frozen (approximately -30^{o}C), boxed, and shipped overnight to our laboratory where they were stored for 4 days at -20^{o}C. On day 5 all chubs were thawed at 4^{o}C for approximately 36 hr with initial sampling on day 6 (week 1). Chubs not used initially were held refrigerated at 4^{o}C until used for weekly evaluations. Sausage mixes had been stuffed in 3 different casings made of co-extruded polyethylene/polyvinyldiene chloride (PE/PVDC) with an oxygen transmission rate (OTR) of 11±3 cc/m^2/24 hr, laminated PE/PE-PVDC with an OTR of 22±6 cc/m^2/24 hr, or laminated PE/metallized (Al foil) PE/PVDC with an OTR of 4±2 cc/m^2/24 hr. Two chubs of each lot-film combination were removed at weekly intervals and analyzed as stated below.

Oxidative stability of sausages was determined from 2-thiobarbituric acid (TBA) reactive substances (TBARS). Samples were analyzed in duplicate following the

distillation method of Tarladgis et al. (1960) modified by analyzing distillates from 10 g samples in 100 ml of the HCl-water solvent. TBARS values were expressed as mg malonaldehyde per kg sample.

For each chub, total aerobic bacteria counts were determined following APHA (1992) methods. An 11 g center cross-section sample was aseptically removed, homogenized in a stomacher for 2 min with 99 ml of 0.1% peptone, serial diluted and then duplicate pour plates were prepared for incubation. Plates were incubated at 35^{o}C for 48 hr and the counts were expressed as $\log_{10}$ colony forming units (CFU/ml) per g of sample.

After removing samples for TBA values and microbiological analysis, the remaining sausage of both chubs was sliced into patties and oven grilled using a slotted grill for fat drainage and served warm to each of 24 untrained panelists. A 9-point hedonic marked line scale was used to rate each sample's overall taste/flavor with 9=very good, 7=good, 5=average, 3=bad and 1=very bad. Although no training was conducted, panelists were familiar with this type product. Product was evaluated only through 8 weeks of refrigerated display.

Main effects of film OTR, display time (week) and their interaction were used in a general linear model analysis of variance (SAS, 1996) with replication effect and remaining interaction used as the error term. Response means were separated utilizing the lsmeans command of SAS.

Results & Discussion

TBARS values did not differ ($P>0.05$) due to type of film or replication. The increases in TBARS values with weeks of display indicate very small yet statistically significant ($P\leq0.05$) changes in the oxidative quality of the sausage after 4 weeks (Figure 1). Sensory rancidity is generally not expected unless the raw pork when cooked yields a TBA value above the range of 0.5-1.0 (Younathan and Watts, 1960; Gray and Pearson, 1987). Murphy et al. (2004) reported very low TBARS values (estimated at 0.5 – 1.5) for a European commercial full-fat (18.7%) fresh breakfast sausage during 12 days of lighted display. Their sausages were small diameter link style whereas the chub-packaged sausages in this study are considered "bulk" packaged. The chub-packaged sausages were approximately 31% fat and did not contain any antioxidant.

Initial microbial counts were 4.3 $\log_{10}$ for mesophillic aerobic bacteria (Figure 2) and 3.4 $\log_{10}$ for lactic acid bacteria (not shown). These are below the 10^5 maximum cited in Roller et al. (2002) for total bacteria counts as a Good Manufacturing Practice recommendation by the Institute of Food Science and Technology (IFST, London). With good sanitation programs and proper handling, low microbial counts were usually found on examination of fresh pork sausage produced in USDA inspected meat plants (Surkiewicz *et al*., 1972). Total aerobic bacteria counts were below 7 $\log_{10}$ until 7 weeks of display. When chubs were examined at 7 and 8 weeks of display, the appearance and odor observed during forming of patties for cooking and sensory evaluation were normal with no slime development, no abnormal color and no off-odor being detected. Even though no defects associated with spoilage were noticed, after 8 weeks of display sensory panel evaluation was discontinued. Other researchers have stated that spoilage (off-odor, off-flavor, sliminess, color deterioration) is generally noticeable when bacterial counts attain levels of $10^6 – 10^7$ (Jay, 1998).

There was no overall effect (P>0.05) on sensory ratings of taste/flavor over 8 weeks of display due to type of film used for chub manufacture. Panel rating means show that sausage packaged in the laminated films with OTRs of 4 and 22 cc/m^2/24 hr rated, on average, approximately 6, between "average (5)" and "good (7)" taste/flavor during the 10 week period (Figure 3). Pork patties from sausage packaged in the co-extruded film with an OTR of 11 cc/m^2/24 hr decreased from a panel rating of approximately 6 ("average" to "good") after week 6 in display to a mean rating of 5 ("average") by week 8. All of these films are considered oxygen barrier films. Panel evaluations were discontinued at 8 weeks of display due to microbial outgrowth exceeding 10^7 – 10^8 cfu/g. No panelist listed any oxidative or flavor defect in the comments section of their panel sheets. Murphy et al. (2004) reported no association between TBARS or microbial counts and sensory acceptability scores for low fat (18.7%) pork sausage in small casing form during 12 days of display. Similar results were reported for acceptability of small diameter sausages evaluated by Roller et al. (2002). The bulk encased sausage in this study maintained quality for a longer period (approximately 8 weeks) as determined by oxidative, microbial and sensory evaluation.

Conclusions

No differences in oxidative stability or microbiological outgrowth were found for chub-packaged fresh pork sausage in films varying in oxygen transmission rate from 4 to 22 cc/m^2/24 hr during 10 weeks of display at 4^{o}C. Panelists rated the taste/flavor of cooked patties up to 8 weeks of display as being between "average" and "good" (rating of 6 on a 9 point scale) except for sausage packaged in a co-extruded film with an OTR of 11 cc which declined to "average" after 6 weeks of display. Bulk style pork sausage appears to maintain quality characteristics longer than similar link or preformed pattie style products as based on prior literature reports.

References

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Tables and Figures

Figure 1 – Thiobarbituric acid reactive substances (TBARS) values (mg malonaldehyde/kg product) of chub-packaged pork sausage in films differing in oxygen transmission rate (OTR) and displayed at 4°C for 10 weeks.

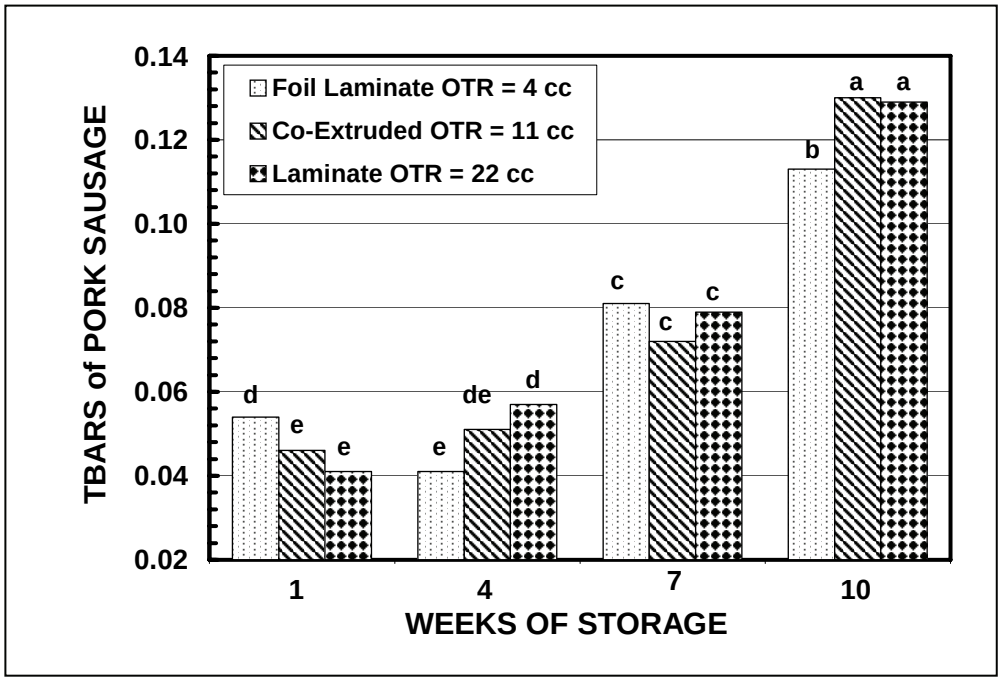

Figure 2 – Total aerobic plate counts of chub-packaged pork sausage in films differing in oxygen transmission rate (OTR) and displayed at 4°C for 10 weeks.

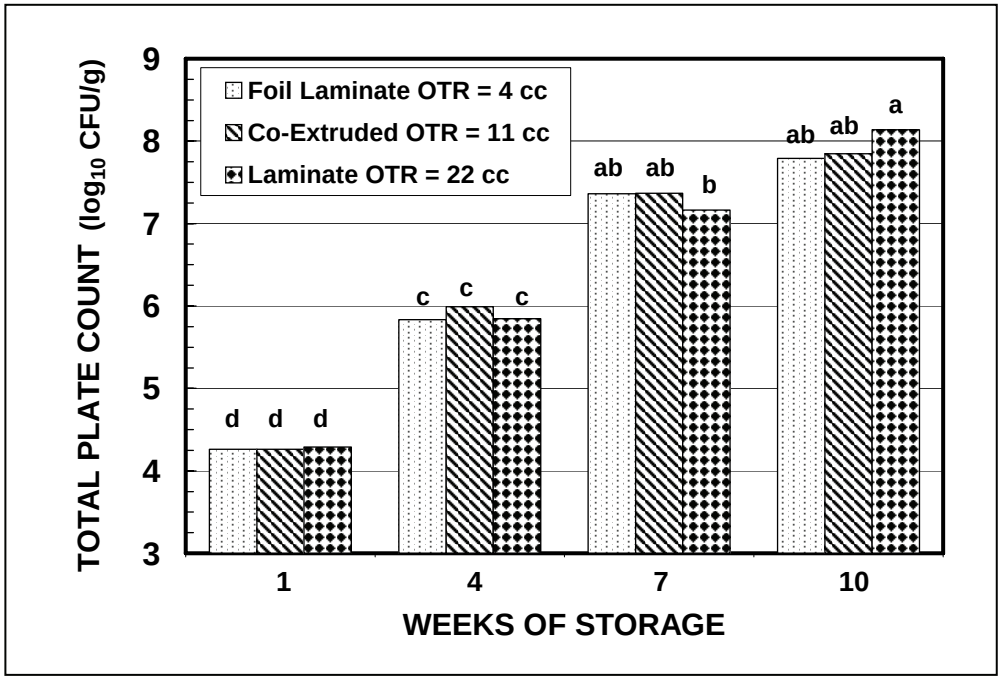

Figure 3 – Panel evaluations of taste/flavor of oven grilled patties from chub-packaged pork sausage in films differing in oxygen transmission rate (OTR) and displayed at 4°C for 8 weeks.