Processed Meats: Ingredients Revisited

Mac W. Orcutt

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The three-part processed meats speaker series will focus on manipulation of processed meat batters to meet expanding consumer expectations of quality and affordability through reformulation, ingredient technologies, utilization of new and evolving technologies, and meat formulation functionality optimization through physical manipulation during key meat processing steps for manufacture of cooked sausages. The cornerstone ingredients of any processed meat product include meat, water, salt and phosphates. Understanding the final desired product characteristics in terms of cooking yields, texture, color, etc. are necessary for manipulation of the ingredients mentioned previously as well as for selection of additional sausage ingredients. As formulators, we are drawn to the less expensive meat ingredients so as to offer a variety of economical, yet quality, processed meats choices to consumers. But as we know, all meats are not created equal; extractable functional protein content varies with ingredients of similar protein content owing to collagen concentration differences, rigor state (pre- versus post-rigor), pH (pale, soft and exudative pork and dry, firm and dry beef), previously frozen versus fresh meat that has never been frozen, etc. Additionally, raw meat ingredient characteristics must be considered in concert with non-meat ingredients selection and combinations, ingredient concentrations and physical aspects of processing to achieve specified desired sausage yields and quality characteristics on a continual basis. Further, salt concentration and the combination of salt and phosphate must be matched to appropriate functional meat protein extraction processes to offer protection from fat separation during thermal processing, promote sausage texture development and optimize manufacturing yield.

Mac W. Orcutt, Ph.D.
DuPont Nutrition and Health
4300 Duncan Avenue
Saint Louis, MO 63116
mworcutt@solae.com

Most meat ingredients characterized as binders are thought only to offer means to reduce formulation cost, often compromising both taste and texture. However, essentially all binders have multiple uses in cooked sausage formulations; and these should be both understood and exploited. Ingredients classed as binders improve texture, control package purge, protect the meat system from fatting out during cooking, improve cooking yield and, in combination with water, replace meat. Meat binder selection should be matched to required ingredient functionality. Moreover, binder ingredient combinations are essential for replacement of a large portion of the meat block in sausage formulations containing low concentrations of highly functional meats, such as many international formulations. Additionally, altering means by which the sausage products are processed such as by converting from collagen or cellulose casings to co-extruded casing for overall cost savings may necessitate major reformulation due to processing challenges associated with handling low viscosity meat batters. Strong, pre-formed sausage casings, such as cellulose and collagen casings, allow manufacture of economical sausages possessing low batter viscosities. Replacing cellulose or collagen casing via co-extrusion is often the only means to remove costs from many low cost sausage products. Binders or novel means of incorporating binders into sausage formulations are technologies that can be utilized to increase raw meat batter viscosity economically without negatively altering sausage appearance, texture and flavor. Traditionally, starches, isolated soy protein, soy protein concentrates and carrageenans in combination with water have been utilized to mimic cooked sausage meat. Recently introduced soy fiber has been utilized in various meat formulations to augment cook yields, offer additional purge control and increase meat batter viscosity without affecting final cooked sausage texture. Similarly, carrageenans solubilized and gelled prior to incorporation into the meat batter may function to alter meat batter viscosity without altering final sausage texture. In addition to revisiting functional ingredient basics, an objective of the presentation will be to demonstrate use of various binders as a means for improving raw meat batter performance allowing greater sausage manufacturing versatility.

A finely comminuted sausage formulation containing 50% mechanically separated poultry as the only multi-functional meat ingredient and no other source of salt soluble protein serves as a model system to study influence of binder addition on meat batter viscosity, sausage texture, etc. The following data summary is a result of a study that was completed in duplicate; data for three replicates will be presented during the June technical session. The base comminuted sausage formulation described in table 1 was modified to contain various additional binders incorporated into the formulation at commonly used levels. All formulation ingredients (mechanically separated poultry, raw minced pork skin, water, etc.) with the exception of the corn syrup solids and the additional binder ingredients remained constant across all binder treatments; corn syrup solids concentrations were adjusted across treatments to accommodate addition of each binder ingredient. Various binders evaluated expressed as a function of raw meat batter formulation content included 3.7% native corn starch, 2% soy cotyledon fiber, 0.3% guar gum, 3.0% dairy whey concentrate (86% crude protein), semi-refined iota carrageenan used as a dry ingredient at 0.8% of the formulation or pre-gelled also utilized as 0.8% basis of the formulation in hydrated form comprising 20% of the formulation, refined kappa carrageenan used as a dry ingredient at 0.8% formulation or pre-gelled as 0.8% of the formulation on a dry basis in hydrated form comprising 20% of the formulation, 3% pre-gelled modified potato starch added via dry addition and 2.5% high gelling isolated soy protein. (Table 1)

Sausages were prepared utilizing standard industry blender and mincer combination practices; procedures will be detailed during the formal presentation.

Back extrusion force served as the means to represent meat batter viscosity. Most binders evaluated tended ($P < 0.05$) to increase meat batter viscosity over that of the control. However, lack of back extrusion force replications for each binder treatment resulted in an inability to separate means statistically despite the fact that there were large differences across treatments with regards to back extrusion force with relatively low standard deviations for each treatment mean. Viscosities of the low cost frankfurter formulations comprised of mechanically separated chicken and a mixture of minced raw pork skin and water (1 part pork skin to 2 parts water), as measured by back extrusion force, tended ($P > 0.05$) to be increased by the addition of various binder ingredients (3.7% native corn starch, 2% soy cotyledon fiber, 0.3% guar gum, 3.0% dairy whey concentrate (86% crude protein content), semi-refined iota carrageenan used as a dry ingredient at 0.8% of the sausage formulation or pre-gelled also as 0.8% of the formulation on dry basis in hydrated form comprising 20% of the formulation, refined kappa carrageenan used as a dry ingredient at 0.8% formulation or pre-gelled also as 0.8% dry basis in hydrated form comprising 20% of the formulation, 3% pre-gelled modified potato starch added via dry addition and 2.5% high gelling isolated soy protein). Isolated soy protein, both pre-gelled (hydrated) semi-refined iota and refined kappa carrageenan and guar gum provided the greatest increase in raw minced meat batter viscosity. While dry ingredient addition of both the refined kappa and semi-refined iota carrageenans, pre-gelled modified potato starch and soy cotyledon fiber provided intermediate increases in minced raw meat batter viscosity.

Cooked frankfurter texture profile analyses (TPA) hardness measured when the cooked sausages were maintained at room temperature (23^{O} C), was increased ($P < 0.05$) over that of the control by all binders evaluated with the exception of guar gum; while cooked sausage cohesiveness (texture measured at room temperature) of the control was not different ($P < 0.05$) than that of the sausages containing the additional binders, with the exception of the sausages containing soy cotyledon fiber and refined kappa carrageenan added as a dry ingredient or as a pre-hydrated gel to the meat blend prior to mincing.

Most small diameter finely comminuted sausages are consumed warm or hot. Therefore, for this specific sau-

Table 1. Finely comminuted sausage formulation

Ingredient	Formulation Content, %
Mechanically separated chicken	50.00
Water	28.94
Minced pork skin (1 part raw pork skin to 2 parts water)	9.36
Salt	1.70
Alkaline phosphate	0.40
Cure salt (6.25% nitrite)	0.13
Sodium erythorbate	0.03
Spice	2.00
Potato starch - Modified (PenCook 1000)	3.72
20 DE corn syrup solids	3.72
Total	100.00

sage texture characterization, sausage sample temperature at the point of TPA analyses should be representative of sausage consumption temperatures; a temperature of 60° C was selected for TPA analyses. Hardness measured when the cooked sausage was 60° C was not different ($P > 0.05$) from the control for the high gelling isolated soy protein, native corn starch, both dry addition and pre-gelled iota carrageenan, guar gum and pre-gelled modified potato starch; whereas, cooked sausages containing soy cotyledon fiber, dairy whey concentrate and both pre-gelled and dry addition kappa carrageenan possessed greater ($P < 0.05$) hardness values than the control. Cohesiveness values for cooked sausages of the various binder treatments were similar ($P > 0.5$) to that of the controls when TPA evaluations were conducted when sausage temperatures during evaluation were maintained near 60 ° C.

All binders evaluated, with the exception of native corn starch, guar gum and the dairy whey concentrate contributed to increasing meat batter viscosity to a large degree, thus removing these three from further consideration as a means to improve raw meat batter characteristics. Binders that offered viscosity improvement while not altering sausage texture dramatically (both hot hardness and cohesiveness values essentially equal to the controls) include isolated soy protein, pre-gelled modified potato starch and iota carrageenan added as a dry ingredient and as a hydrated pre-gelled ingredient. Soy cotyledon fiber and the kappa carrageenan (both dry addition and pre-gelled) offer texture hardness enhancement in addition to increasing finely comminuted sausage batter viscosity.

Meat binders are generally considered a means to reduce meat formulation cost; summarized data demonstrated additional uses for selected meat binders including thickening of raw meat batters to enhance processing capabilities and cooked sausage texture hardness improvement. Raw formulation costs would be greater than that of the control for all experimental sausage formulations described in this study. These costs would have to be offset by process improvements. Formulation modifications could allow modification of processing methods used to produce the finely comminute sausage, offering savings in cooked product cost not permitted by the original formulation. Formulation and final product costs will be provided during the technical session that will further aid selection of binders best suited for particular product and process scenarios.