

ience has been working with the poultry and red meat industry, mostly in the processing area. Recently we've done a good bit of work with poultry plants which restructure items and we have been involved in the development of some new products relative to the use of mechanically deboned poultry.

I'd like to first emphasize one major criterion. I made the statement a while ago that today we are in the food processing business. We are food processors, we're not necessarily meats firms. We're going to have to cross the threshold of being a little more versatile in looking at combinations of meat and poultry; meat, poultry and vegetables; meat, poultry and seafood; and some other types of products that have been developed. Most of the literature that I reviewed in preparing for this session dealt with whole muscle and the adherence of batter to the skin. Today we're looking at restructured products.

I think the biggest problems that I've seen from my experience deal with forming the product. You have to be careful as to the temperature of the product as it goes into the batter and breading operation. If we are using fresh product and it's moist, we have to look at the use of a pre-dust or something to absorb the moisture so we get good adherence of the batter, of protein-protein interaction, as we would refer to it in the meat industry.

Jim didn't refer to the specifics of how we formulate in the machining of a product. In most cases, after the product has

been formed, regardless of whether it is a frozen product or whether it is coming off a forming machine, we usually go through a pre-dust. We come out of the pre-dust and then go into a batter. These batters may vary from very thin, depending upon amount of pickup that we desire, to very thick. Obviously, the consistency of the batter is a critical control point. It deals with the amount of pickup and the amount of yield that we would expect from that product. From there, we go through a blow-off process to remove any excess batter to keep from contaminating our breading. Each of these steps has some highly technical transfer apparatus to make sure that we get uniform coating of batter and breading on the product and a total encapsulation of the product. Total encapsulation is very important from a cook yield standpoint.

Lastly, we go through the breading. In this step, we are looking at some very recent innovations of equipment that are able to handle something of a very fine texture all the way to a Japanese bread crumb. After we come out of the breading, we go into the deep-fat fry for blanching or setting.

Jim has just outlined the different types of combinations. I think that one of the things that we need to consider today in the meat industry and food industry is the utilization of horizontal ovens in frying, whether we are presetting or fully cooking. In one of the plants that I have been working, fully cooked product is being produced with a 96% to 97% yield out of the oven. I think that's phenomenal.

Discussion

J. Farr: Before I open up the floor for discussion, I would like to mention that the poultry industry is in a rapid transition and that the market is controlling what is being innovated.

J. Guenther: Red meat people have recently been talking to chicken people. I always forget we're all in the flesh food business. How do you envision mixing poultry and red meat and what types of labeling problems do you think will result? I'd like to hear some reciprocity along those lines.

E. Reynolds: I don't really see any great problem. In our Meat Science Institute at Georgia this year, we covered the topic dealing with the sausage area and labeling requirements. We had nearly 100 different products that were brought in from all over, everything from smoked sausages to bolognas, some were restructured products containing combinations of meat and poultry. As long as it was labeled according to the ingredients contained, there didn't seem to be any problem. In Gainesville, Georgia today, we're producing a 90% lean product with 10% chemical fat delivered to your door either in a pre-blended form or frozen 50 lb. blocks for 23¢ per pound. I think when we consider that we have this type of product available, we have to wake up and look at different ways to utilize it.

Guenther: In fact, I was really referring to pictures of products that you had in the National Provisioner. What was the poultry content of those sausage items at your Meat Science Institute?

Reynolds: They ranged from 15% to 75%.

A. Pearson: I recently had the opportunity of visiting with the largest processor of poultry products in Michigan. He told me they had made some very good mixed products, but he

said their acceptance has gone down and he felt that the consumer, at this time at least, preferred a straight product with which he was acquainted; for example, a beef product or a pork product. He said the consumer expected it to taste like beef, pork, or poultry rather than the mixed product. Do you think that in the long range that this is going to be a problem?

Farr: I can only speak of the experience of one operation that did produce a combination poultry-red meat type formed item and the market on it did dry up.

Pearson: It may be that they will accept a mixed product after they become used to the taste of it, where originally they expect something different.

J. Regenstein: I think one of the problems with the mixed products is that consumers don't know how to evaluate perceived value. When you're buying beef, you're paying for beef, you're getting it. But when you get a turkey/beef product, consumers question why they are being mixed.

D. Rice: I have one comment on the fact that we're seeing a lot of use of fanciful names. The consumer is beginning to accept products that don't necessarily have a traditional name. Perhaps we can utilize fanciful names for some of these mixed products.

Pearson: I want to change the tenor of the meeting. I have two questions. The first is: Does anyone here have experience about imparting antioxidant properties to the breading and the batter in such a way that you can prevent oxidation of these products during storage and during reheating? The second question that I want to ask: Is there a problem with these batters and breadings becoming soggy?

J. Cordray: From my experience, it is more successful

from an antioxidant standpoint to include an ingredient in the meat as opposed to having it in the batter and the breading. One additive which I have found to have very good antioxidant properties in restructured products is phosphates. I have found phosphates to work very well in extending the shelf life of restructured products when used at a level of .25% to .35% in the finished product.

Question: What about fully cooked product, do the phosphates help in any way to decrease warmed-over flavors?

R. Sleeth: I think, as far as the restructured products are concerned that we are making from chicken meat and turkey meat, the quality of the product is directly related to the raw material. Irrespective of what we put in afterwards, if we don't treat that raw material correctly, we're going to end up with unsatisfactory products. Other than utilizing the material directly from a mechanical deboner into the product; in other words, fresh right off the line or adding some cure to it and then perhaps freezing it for a while, I don't know any other way to really preserve or keep the good keeping qualities of that product.

Farr: O.K., we still haven't answered the second question.

Regenstein: I have seen a number of ads in food magazines that said their battered and breaded products were microwave-compatible. Usually, this is the ultimate in the sogginess problem. Has anybody actually put out a product or worked with a product that was successful in making a breaded and battered product crispy in the microwave?

Farr: I can only relay to you secondhand information. A couple of companies have indicated that they are having some success with a product of that type. One of the challenges to me that we have in the area of utilization, no matter what the primary ingredient, is the kind of market we are aiming at. This is going to dictate on the batter and breading process itself and the makeup. We are going to be raising questions now; are we going to reconstitute it in a convection oven, hot oil or a microwave? As products are developed, these are some serious questions that must be answered.

C. Hackney: On a little different topic, you indicated that restructured products from white meat seemed to do better than products from dark meat. What are you going to do with the dark meat?

Farr: I was asked that very thing a few weeks back. Is anybody here from Clemson? They have been approaching this problem from an interesting standpoint. They are experimenting with a blanching procedure for the dark meat. Most of the fast food chains are using a mixture of white and dark meat nuggets. They manufacture white meat nuggets and dark meat nuggets and then they mix them in packaging. It's not done simultaneously down the line. What they are seeing is that the actual binding characteristics of the dark meat differ from white meat, that it has more oil in it; consequently, it seems to fall apart a little more readily. They can't get the dark meat nugget to form as well as they can the white meat nugget. This can also be related to the method used in the processing plant to remove the meat from the bone. Dark meat deboning is somewhat variable. We still can produce a fairly constant product if we use a hand-deboned thigh, but many companies right now are moving toward mechanically-deboned thigh meat. They use a water knife that actually takes a cut down the thigh bone and then uses a circular

spray to separate the meat from the bone. When the thigh is placed in the machine, it is roughly 35° F, when it comes out in 30 seconds, it is roughly 70° F and the water content is quite high. How much of this excess moisture is retained depends on how the product is handled. There are several other things that I observed, but, in a nutshell, dark meat binding appears to be a problem and there must be more work done in this area.

Cordray: I have a question for you, Estes. Have you had any dealings with how nonmeat proteins affect breading and batter binding to a product?

Reynolds: In reviewing the literature before we were getting ready for this meeting, I looked at some work done at Kansas State on the use of gelatin and egg albumin. When you increase the protein content in the flour portion using these, you get a little better binding adhesion to the surface. This was in whole muscle-cuts, such as legs and thighs.

Cordray: Jim, you made the comment that you didn't think this type of item would go in the retail market, that it needed to stay in the HRI trade. That statement is of some concern to me because it seems to me for the success of this type of product we certainly have to address the HRI, institutional as well as the retail trade. Why do you think that these products would not be successful at retail?

Farr: I feel that if you go to retail, it's going to be more of a challenge to get the consumer to accept it. I think that unless there is some identity for buying a product, there is resistance. Sure, you can put the advertising dollar pressure on consumers and get some, but I don't think you're going to be readily accepted. I feel future dollar return on your advertising would be greater in the institutional market than in the retail trade. I do think that we ultimately will see the day that we will cross over. I really feel that at some point in time we will start labeling things as far as how they taste. According to some of my friends at Iowa State, they were able to successfully make Canadian bacon out of turkey so that you couldn't distinguish the difference between the pork and turkey products. I feel that we will be seeing more and more blending. When we get into restructured, I think we will probably see some seafood coming over as an ingredient because of some of its characteristics that could be utilized in gel formation.

Question: I have a question for you, Jim. One of the big problems or one concern many times people have with breaded and battered items is that when the product is reconstituted, sometimes the batter and the breading does not adhere to the product. Would you discuss the importance of viscosity in determining how successful a batter and breading operation is going to be?

Farr: The biggest thing that I've seen is that the problem occurs if the product is raw and very thick. You can have a good bit of cook-out of oil, causing the batter to become loose on the surface in its reconstitution and sometimes sloughing off.

You would see this probably more in dark meat products than you will in white meat. This is one of the things that needs to be considered when you look at dark meat nuggets. The dark meat is where you can have some initial adhesion problems. It's also a product that has more fat in it as a general rule and it's not as tightly bound. I question that in some of the recipes, processors are actually achieving what

they think they have in their protein and fat composition levels; therefore, they may be having a breakdown and separation based on the cooking procedure within the meat itself.

Question: I want to know how important the protein content is as far as the coating content in batter is in determining the binding experience to the skin surface? In other words, what kind of wheat flour is used?

Farr: It usually is a hard wheat flour.

Question: All-purpose, as opposed to 10% protein or lower or higher?

Farr: I would think you usually run most of the time just slightly higher.

Cordray: I think also that a lot of times you have to take into consideration that there are certain things that many times are added to the breading that will help contribute to the protein content. Things like perhaps nonfat dry milk might not be nearly as good a source of protein as perhaps gelatin. Have you done any experimentation, Jim, with different types of gums and how they reflect on this?

Farr: No, Bob Baker at Cornell did some work in this area. Right now, most of the breading companies will help in the adhesion areas. Some of the starches can actually affect the crispness of the product and the absorption that you will have of oil during the frying process. I was visiting an operation a few weeks back and they raised the fact that the ingredients within the batter material itself can also affect the life expectancy of their frying oil. This gets back to the equipment again where we talk about dealing with an electrically-heated fryer versus a gas-heated fryer and the ability of the scraper in the bottom where the heat source or the rods come in contact with grease. I'm told it's a little more complex with an electrically-heated fryer. The starches and modifiers used can definitely have an effect on the life of the oil with regard to color and breakdown.

Reynolds: I would like to make an additional comment relative to the question on protein content. Recent work by Cunningham in Kansas relates to the use of protein additives; nonfat dry milk, gelatin and egg albumin. Egg albumin is the traditional additive in the batter, usually using about 2%. The gelatin was effective in increasing the yield and adhesion while the egg albumin gave the best results.

Farr: One had a toughening effect, I believe.

Reynolds: The egg albumin does give a slight toughening effect in the batter but gelatin doesn't give nearly the resistance to shrink loss during cooking as did the egg albumin. They used five different gums, but carboxymethylcellulose was the one of choice and it showed considerable yield differences.

W. Means: What about the use of nonmeat proteins or hydrocolloids if you're making a restructured product? If you include those in the formulation of the meat product, will that help soak up the oil or retain moisture so you wouldn't have problems with the breading when you get to that stage?

Farr: There has been some work on products made from the caseinates and soys relative to bite and texture. This has been company work and not under laboratory conditions, so I can only say that they have tried to do this. As far as absorption of fat, I can't respond in that area. As far as utilizing these actually as a portion of the batter, I think Cunningham did work in that area but I cannot right now

recall the results.

Reynolds: They increased the yield and by doing so absorbed some of the fat.

Question: On the outside of the product, not incorporated in the product?

Reynolds: I didn't see anything where he was incorporating it into the batter. This was incorporating it into the product.

Question: How frequently do you change your cooking oil?

Farr: I'll respond and then let Estes respond to see if our opinions differ. Basically, they say they're replacing it on a continuous basis according to what is absorbed in the product during the cooking procedure.

Question: You replenish, but you never change?

Farr: Never change, except maybe during a downtime. They don't turn it over that much, but they are constantly filtering in a closed recycled system.

Question: What about free fatty acids and pH?

Farr: They would monitor these. They will have to drop it about every two days or so, usually because of this problem occurring. This will vary with the types of products produced and is also related back to their batter/breaders. They have seen differences occur.

Question: During cooking, are polymers formed?

Farr: Right, and what you have seen here is certain starches affected differently. We haven't even gotten into the interaction of the different oil mixtures.

A. Booren: I am reading through this conversation that one of the major changes over recent years, say the last ten, is to look at types of battering and breading and oil absorption during cooking. Is this in fact true, number one, and is that the direction we're going toward, less oil absorption? It would seem to me, if that is the case, are we as an industry going toward eliminating the oil cooking completely and going to another method of cooking or possibly radically different battering and breading systems? Do you foresee any of those types of changes on the horizon?

Farr: I see no immediate changes at the processor level. I think there's going to be a fairly continuous market in the foreseeable future. Most operations that are cranking up plan to use oil as a cooking medium. We probably will see a moving away from reconstitution in oil of products that have been par-fried. One problem is that most fast-food outlets are fixed as to their interior floor space, so they can't at will add different types of equipment for different methods of reconstitution. I do see a movement in the institutional market, schools and such, toward increased use of microwaves and convection ovens. But I don't see us just completely replacing frying as a reconstitution method.

Reynolds: One of the things that we see that has a tremendous economic incentive is the use of a blanch, using the fryer simply to set the batter and following this with horizontal convection ovens. The yield is tremendous with this type of process. When you're coming out with a finished cooked product, battered and breaded, with a 96% yield, there is a tremendous incentive to use that procedure.

Booren: Well, that's what prompted the question and I guess I can see myself visualizing a short-circuited system here where you actually use the batter and breaders to absorb your cooking loss and to keep it. That's exactly what you're saying, is it not?

Reynolds: Pretty much. We haven't laid it out, but with one-pass batter and breading you're talking about a 25% uptake. If you want to restate that, on a pick-up basis, that's 125% yield. When you cook it, even with a 20% cook loss, you are still back to the original weight of the product. So the economic incentive is there. For example, you see fried okra and fried squash on nearly every salad bar. They're getting anywhere from a 20% to 30% pick-up on an item that costs only 20¢.

Farr: I would like to take this question back to when we were starting to cook bone-in products. We found out that if we could pre-cook the meat, we usually could keep the yield up and have less cooking loss. We've had numerous companies that have utilized the batter and breading of steam-cooked or water-cooked products. Some that are ongoing today are taking raw product, battering and breading, par-frying and then infrared cooking and still coming up within the 90% yield range. However, you cannot be competitive in the bone-in, battered, breaded product if you can't hold a yield close to 96% to 98%.

D. Owens: What level of oil uptake do you tend to get?

Farr: I have been told it is around 13% to 14% in the batter and breaded restructured products.

Owens: What amount of batter and breading is typical on nuggets?

Farr: That is so varied depending on what you are trying to do, you almost ask what they want, thick or thin, and you can produce it that way.

Booren: Is the consumer demand toward more breading or less breading? If you were going to poll the consumer right now, what do you think the consumer's looking for, the breading or the meat?

Farr: I would guess it would be the latter, the meat.

Reynolds: I think we're seeing something occurring with the new technology with batter and breading. The improvement of yield also improves the juiciness and moisture content within the product, especially in restructured products. It's to the extent that they're now taking frozen vegetables and pressing the frozen vegetables together. They can press this frozen vegetable and use the ice crystal formation to form a solid block and then form this into a shape, batter and bread it, and then deep fat fry or blanch. What you're seeing here is a very moist and very tender product. It is super with vegetables; and by doing this with a restructured product, you can retain all of the juiciness, flavor and texture of that product at its height. I think we are going to see combinations of meat and vegetables in some products. In some products, the batter itself is giving integrity to the product. I don't think this is something we have thought about too much in the past.

Farr: That really drives the point home that this is a very fluid type of a market.

J. Sebranek: How much flexibility do you have in compositional formulation? I'm asking because some of the consumer groups have been critical, for example, of the nugget products from a nutritional standpoint. In fact they have been criticized rather severely.

Farr: Let me approach it from this standpoint. We've had enough variation in the protein, based on the harvesting or de-boning method that is used in collecting of the product, particularly the dark meat, that they're getting a recipe or

formulation which was at one time successful, that's now no longer successful. For instance, let me give you an example of what's happening. For deboning breast meat, we use combs and the meat is manually stripped. There are still a few manual operations that are taking the dark meat off; however, there are also several mechanical means. One machine that we saw recently was doing 157 thighs per hour and was de-boning entirely by water. This could give a raw material with a higher moisture content than a hand-deboned product.

M. Bailey: What is the shelf life of these products frozen at -18° F? How well do you think your processing procedure stabilizes the flavor, particularly against oxidation.

Farr: On restructured, I can't give you a real estimate. Working with whole tissue, bone-in product, you'd use a phosphate stabilizer, you usually can get a three-month safety test with no changes in flavor by panel detection and sometimes extended to six months. Going back to some of my own research on my dissertation, we were testing flavors on a phosphate-treated product, either cooked and/or stitched. We even found a new procedure which was a surface cooking application. With these procedures, we could get up to six months shelf life with very little or no difference against a control.

Bailey: Does the use of phosphates and salt enhance the yield by water binding?

Farr: Definitely in cooking and injection, yes, this is common in many products.

K. Jones: The question I had was: How can the crispiness of the breading be maximized with microwave reheating, say at the consumer level or possibly down the road in franchise operations?

Farr: There is a product on the market by one of the starch companies that is supposed to assist in improving this very factor. It is incorporated into the batter. I haven't tried it. I have had some interesting experiences with microwaves. When I was at Mississippi State, a corporation loaned us a very powerful unit. It could cook a chicken so rapidly that it would still taste raw. Temperature-wise, it was 180° F but it tasted like raw chicken. It took about 80 to 90 seconds to cook the chicken.

Question: What was the color of the meat?

Farr: It looked raw, it looked just like it tasted. It didn't have a chance to go through all the precursors in the normal procedures for cooking.

D. Schafer: Would you anticipate much of this technology being used in the red meat industry?

Cordray: I think it is essential if the red meat industry is going to keep pace.

Reynolds: It's not only if it's going to keep pace, we will have to do it to remain competitive.

Farr: If I can speculate down the road and dream a little, to project about 10 years into the future, I think we're going to see in restructured products that we use all three, poultry, red meats and seafoods, in various formulas. These products will be shaped, seasoned, and incorporated with vegetables and various types of entree dishes. We are going to see products prepackaged for reconstituting by microwave and various quick heating packages. We are going to see the old rigid laws dealing with red meats, poultry and seafood breaking down very, very, rapidly.