



Effects of Soft Wheat traits on wheat flour to make batters and breaders

Stevan Angalet, PhD

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Coated Foods



- ◆ **SRW flour has found its way into many coated food recipes of the American cuisine.**
- ◆ **I will only touch on a few that have evolved into the mainstream and are supported by highly mechanized & choreographed production systems.**

Batter & Breader



- ◆ **All the recipes are based upon the dipping of the selected food into a batter [comprised of flour and water]**
- ◆ **Some recipes use a secondary addition of flour on top of the batter called a flour breader.**
- ◆ **Many of these recipes are noted in cook books from antiquity and around the world.**



Hand Batter Coating



Photos of familiar coated foods



- ◆ **Onion rings**
- ◆ **Chicken [patties, nuggets, strips, wings, bone in, etc]**
- ◆ **Chicken fried beef steak**
- ◆ **Shrimp**
- ◆ **Fish**
- ◆ **Calamari**
- ◆ **Vegetables**
- ◆ **Cheese**
- ◆ **Mushrooms**



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Cheese Sticks



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Shrimp



(c) Cooking On the Side



Chicken Nuggets



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Onion Rings



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Calamari



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Wings



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Vegetables



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Chicken Strips



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Fish Sticks



Literature



- ◆ **Olewnik, [AIB] wrote a chapter Factors affecting performance characteristics of wheat flour in batters in “Batters and Breadings”, 1985.**
- ◆ **Flour quality factors studied:**
 - **Protein**
 - **Starch damage**
 - **Enzymes**
 - **Oxidants**
- ◆ **Effects measured**
 - **Pickup**
 - **Viscosity**



Viscosity



- 1. Important end-use attribute for batter SRW wheat flour formulations, which are formulations with minimal gluten development.**
- 2. Important to leavening gas retention and flow characteristics. [Many authors to include Betteg and Morris 2005]**



The Batter Breader Industry



- ◆ **Since 1950, a large wheat flour batter and breader industry has arisen with the advent of frozen dinners.**
- ◆ **Existing food companies re-positioned themselves to make batter mixes.**
- ◆ **New food companies arose to manufacture batter mixes.**
- ◆ **New and old retail food companies focused their businesses to process foods with batter mixes.**
- ◆ **Equipment companies helped to design and manufacture application machines to address the high volume production required.**
- ◆ **Advent & growth of Quick Serve Restaurants [QSR].**
- ◆ **The present supply chain to deliver these foods is populated with many companies and workers to convert the wheat flour into these delicious and popular foods.**

Types of Batters



- ◆ **Conventional [unleavened]batter – simple formula made with wheat flour and water. These batters are pumpable and suitable for continuous mixing. They are adhesion batters to act as glue to hold other materials onto substrate.**
- ◆ **Leaven batters [tempura] – only outside coating. The chemical leavening action adds gas bubbles to the coating.**



Batter mixing



- ◆ **High volume batter mixers are capable of mixing up to 3,000 lbs of batter per hour. The rise in raw material and energy prices means that firms have to look at every aspect of the supply chain to identify where possible cost savings can be made.**
- ◆ **Because of advanced technology: equipment can automatically monitor viscosity, eliminate lumps, and mix different types of batter.**
- ◆ **Processors need:**
 - **consistent batter viscosity [the viscosity control that monitors and maintains batter thickness controls to +/- 1 percent from set point]**
 - **Consistent batter pick-up**

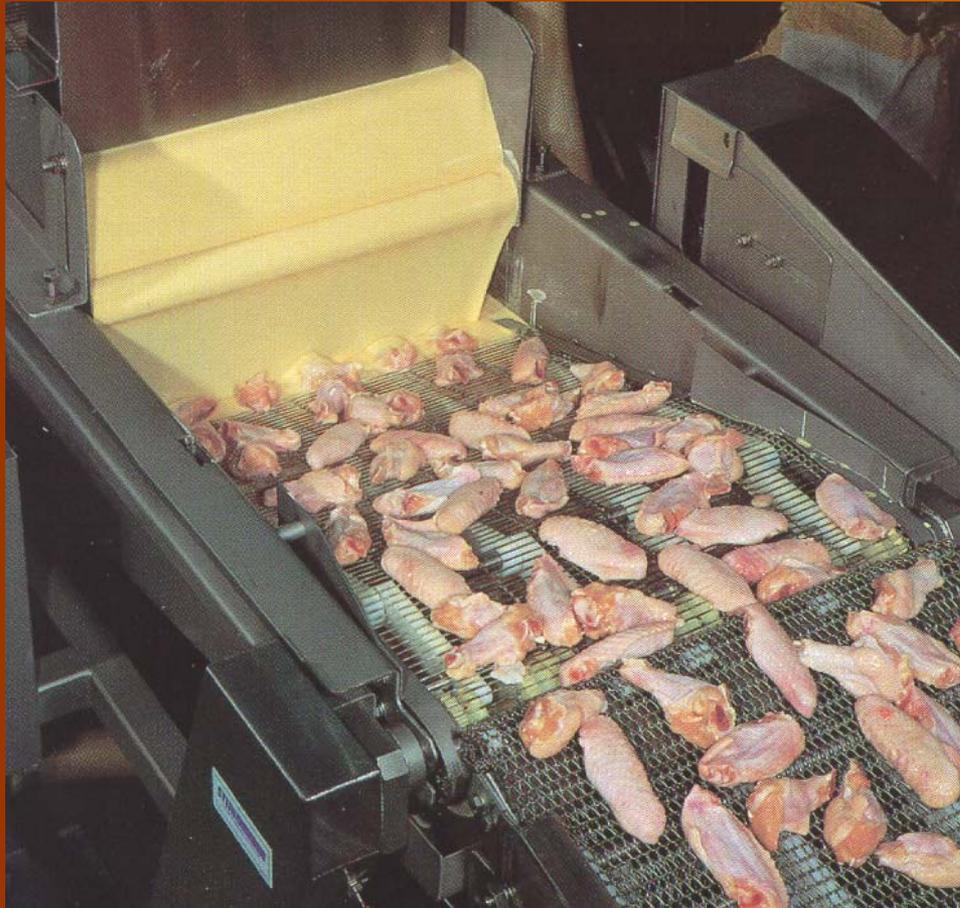


Waterfall applicator



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Coating Chicken Wings



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Pilot Line



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Where is SRW Used?



- ◆ **Literature on SRW classically directs readers to cakes, cookies, pastries, pie crusts, crackers, and biscuits. Atwell, 2001.**
- ◆ **Why not batters and breaders?**
- ◆ **Let me show you some economic examples of the importance of batters.**



CATEGORY REVENUES [US\$]

[L. Groton, 2008]



- ◆ Bread and cake, \$23.8 billion
- ◆ Snack foods, \$12.2 billion
- ◆ Cookie cracker, \$10.4 billion
- ◆ Breakfast cereal, \$8.9 billion
- ◆ Candy/confectionery, \$8.9 billion
- ◆ Chicken nuggets [all makers] \$4.5 billion [S. Angalet added 2010]
- ◆ Prepared flour mixes/dough, \$4.3 billion
- ◆ Frozen bakery products, \$4.2 billion
- ◆ Frozen pizza, \$1.6 billion
- ◆ Tortilla, \$1.5 billion
- ◆ Dry pasta, \$1.5 billion



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◆ Statistics on size of business

Market Value - All Chicken Nugget Businesses



- ◆ 1.8 billion servings annually of chicken nuggets [2007 NDP group]
- ◆ 6 pieces per serving [range from 4 to 20]
- ◆ \$2.50 per serving [variable]
- ◆ \$4.50 billion annually

How much SRW does it take to make coated chicken?



- ◆ One QSR [IRI data 2004] sold 300 million lbs [chicken nuggets] requiring 54 million lbs of soft red winter flour.
- ◆ Another QSR [IRI data 2004] sold 65 million lbs [chicken fillet] requiring 14 million lb of flour.
- ◆ These 2 recipes alone take 91 million lbs of wheat or about 1.51 million bushels requiring 38,000 acres to produce.



Appetizer Data



- ◆ **One large company made 50 million lb annually of battered onion rings [QFF, 2004] requiring 11 millions lb of SRW flour.**
- ◆ **A single production site employing 277 produced 70 million lbs annually [QFF, 2007] of onion rings, mushrooms, vegetables, and cheese sticks requiring 15.4 million lbs of flour.**



IRI Data on Some Foods [2004]



Here are a few more statistics from retail frozen food firms:

- ◆ **National brand chicken** **\$176,203,872**
- ◆ **National brand seafood** **\$167,157,360**
- ◆ **National brand onion rings** **\$175,000,000**



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SRW Statistics



- ◆ **2009 SRW crop was 412 million bushels**
- ◆ **Export was about 89 million bushels**
- ◆ **Domestic consumption would be 323 million bushels.**
 - **Remember that 2 QSR items required 1.5 million bu. Or 0.5% of the SRW wheat crop.**
- ◆ **Domestic milling of all wheat [2007] was 1,400,000 cwt daily at the 170 USA mills**



Soft red winter wheat [milled to flour] is purchased from the following regions



Conversion of Wheat to Wheat Flour



- ◆ **Wheat is received by millers**
 - **Origin mill**
 - **Destination mill**
 - **Combination**
- ◆ **Mills have variety of equipment and construction dates.**
- ◆ **Each mill has own miller perspective for milling wheat into flour.**



Wheat Flour



- ◆ **The food prepared in the grinding and bolting of cleaned soft wheat.**
- ◆ **Flour defined via specification.**
- ◆ **Specification developed upon the customer requirements for their finished product.**



Measurable Soft Wheat Characteristics



- ◆ Quantity of Protein
- ◆ Quality of Protein
- ◆ Sprout damage [cereal α -amylase]
- ◆ Endosperm color
- ◆ Starch damage
- ◆ Farinograph absorption
- ◆ Seed coat color
- ◆ Dress
- ◆ Bostwick viscosity



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What is a Flour Batter?



- ◆ **The combination of water and flour [1.5 to 2.5 parts water to 1 part flour] and an acceptable flow [or viscosity].**
- ◆ **The purpose of a batter is to:**
 - **Coat a food**
 - **Become a pancake or crepe**
 - **Become a cake**



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Batter Hydration & Mixing



- ◆ **The using facility mixes the required weight of flour mix with weight of water.**
- ◆ **The facility can use a variety of mixing devises.**
 - **Impeller**
 - **Rotating beaters**
 - **Turbulent flow**



Competition of Water



- ◆ **Competition for water is a series of small incremental steps of wheat flour components affinity and rate of water association.**
 - ◆ **Pentosans hydrate early.**
 - ◆ **Starch adsorbs water –surface.**
 - ◆ **Damaged starch absorbs water and starts to hydrate.**
 - ◆ **Proteins start to hydrate and change spatial orientation – uncoil and form network.**
 - ◆ **α -Amylase begins to breakdown starch.**





Upon application

- ◆ **Batter flow**
- ◆ **Pick-up**

Upon heating there are secondary characteristics expressed by the wheat flour.

- ◆ **Color development – browning.**
- ◆ **Texture – the gluten and starch system sets to yield flaky, crisp, or cracker like results. Also the development of voids from steam or chemical leavening.**



Evaluation of Batter [at NWF and at customer]



- ◆ Mix a fixed weight of flour mix to fixed weight of water.
- ◆ Water at set temperature.
- ◆ Mix to fixed time [choreography with rate of manufacture].
- ◆ No foam formed.
- ◆ No un-hydrated clumps of flour.
- ◆ Meet viscosity requirement.
- ◆ Appearance.



What is a Flour Breader?



- ◆ **Dry wheat flour is applied on top of the batter coated food to complement the customer/culinary developed recipe.**
- ◆ **The culinary benefits are:**
 - **Appearance**
 - **Texture**
 - **Thickness**



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The Tools of the Wheat Breeder



- ◆ **Resistance to disease/pests/mold**
- ◆ **Yield [bu/acre]**
- ◆ **Stalk height**
- ◆ **Adapt to environment**
- ◆ **Kernel hardness**
- ◆ **Tolerance to adverse soil conditions**
- ◆ **others**



Bettge and Morris, 2005 – factors affecting viscosity



- ◆ **Single kernel hardness associated with starch damage.**
- ◆ **protein content.**
- ◆ **Arabinoxylan presence affect water holding and effect viscosity of a flour water system.**



SRW is a critical component of USA popular foods



- ◆ **The wheat breeding industry should be aware of the vast array of popular batter & breaded foods enjoyed by Americans, livelihood of food manufacturing businesses, and the people they employ.**
- ◆ **A shift in the genetics of wheat which affects functional quality of protein, viscosity, water holding capacity, sprout damage, etc will alter the present batter breader industry - cost to produce and customer satisfaction.**



Recommendation



- ◆ **Batter and breader should be included as an equal when listing “where SRW is used ” as cakes, cookies, pastries, pie crusts, crackers, biscuits, and batters.**
- ◆ **The SRW wheat flour attributes should remain within current quality ranges.**
- ◆ **If the soft wheat characteristics change too much then batter breader food manufacture will be affected.**
- ◆ **At present batter and breader mix firms have sufficient availability of SRW flour to chose the suitable SRW wheat flour – Not all SRW flour is the same.**

