

Improve Yields, Increase Throughput and Enhance Texture Using Red Arrow's Natural Browning RA03036

Caramel color has been used by manufacturers for decades to achieve the desired shade of brown on a wide array of foods and meats. Recently, ingredients labeled as caramel color have fallen victim to the "Clean Label Movement". However, without the use of caramel color labeled ingredients, food manufacturers encounter one or more constraints when attempting to achieve the brown tone their products previously exhibited.

Constraints encountered by manufacturers when ingredients labeled as caramel color are removed from their products:

1. More capital is needed for specialized cooking equipment capable of managing humidity and generating higher cooking temperatures to achieve brown color tones.
2. Drier cooking conditions and higher operating temperatures are needed to achieve desired brown color tones which in turns leads to lower cooking yields.
3. Undesirable changes in sensory attributes occur while attempting to achieve the desired brown tone without the use of caramel colors.
4. Reduced throughput rates are experienced as cooking conditions are slowed in an effort to achieve the desired color.
5. Higher energy consumption associated with higher operating temperatures and prolonged cooking times are associated with developing brown tones.

To overcome one or all of the constraints stated above, Red Arrow Products has identified ingredients derived from the pyrolysis of hardwoods that are capable of producing favorable brown color tones with little to no flavor impact on finished food items.

Red Arrow's Browning Agents RA03036 and RA04010 are not required to be labeled as caramel color. RA03036 and RA04010 products are highly concentrated water-soluble liquids that are easily diluted for ease of application to food product surfaces. Both of these products are organic compliant, Kosher Pareve certified and have no allergen declarations

Labeling

The USDA does not require labeling of RA03036 or RA04010 if either one is applied to the surface of a meat product followed by exposure to heat, per USDA Policy Memo 058-A. The FDA requires RA03036 and RA04010 to be labeled as Natural Smoke Flavor when applied to non-meat food products.

Study

Red Arrow conducted a study to document the influence of RA0306 on appearance, cooking yields and cooking times on chicken breast fillets. The fillets were cooked utilizing a pre-conditioning oven (pre-heating) and impingement oven (indirect heat fired).

Conditions

Fresh chicken breasts were marinated to 15% over raw meat weight with a solution of water, salt, and sodium tripolyphosphate then vacuum tumbled for 30 minutes. The marinade solution contained 98.9% water, 0.6% salt, and 0.5% Sodium Tripolyphosphate

Control and treatment group fillets were individually weighed prior to placement into a flattening machine to flatten fillets to a uniform thickness. Fillets were placed in a single line with spacing between fillets to allow for weight and internal temperature data collection.

Treatment group fillets were subjected to a 15% concentration of RA03036 via waterfall drench solution for six to seven seconds and then transferred to the impingement oven. All products were maintained in a single line.

Internal temperature of cooked product was targeted for 185°F in an effort to exceed the industry norm and allow for processing variation. All fillets were weighed after thermal processing.

Control

Thermal processing conditions

Pre-Conditioning (Pre-Heating)	
Temperature Top Plates 1-4 (°F)	425
Temperature Bottom Plates 1-4 (°F)	425
Belt Height (mm)	14
Time (sec.)	60
RA03036 Browning Agent	
Concentration	N/A
Drench Time	N/A
Impingement Oven (Indirect -Heat)	
Air Flow (Top/Bottom)	50/50
Temperature °F	435
Fan Speed (%)	95
% Moisture / Volume (Actual)	11
Finger (Hood) Height (inches)	2.5
Total Time (min.)	7.8

Treatment

Thermal processing conditions:

Pre-Conditioning (Pre-Heating)	
Temperature Top Plates 1-4 (°F)	400
Temperature Bottom Plates 1-4 (°F)	400
Belt Height (mm)	14
Time (sec.)	45
RA03036 Browning Agent	
Concentration (%)	15
Drench Time (sec.)	6 to 7
Impingement Oven (Indirect -Heat)	
Air Flow (Top/Bottom)	50/50
Temperature °F	405
Fan Speed (%)	95
% Moisture / Volume (Actual)	80
Finger (Hood) Height (inches)	2.5
Total Time (min.)	7

Results

The total number studied in the respective groups was 95 pieces (n=95). The initial (raw marinated) target weight of each group was 170.25 grams. The control fillets had an average marinated raw weight of 169.26 grams versus 169.30 grams for treated fillets.

All fillets were placed in the same lane on both pieces of equipment. In addition, the conditions within the pre-conditioning oven were different for the control group versus the treatment group (see thermal processing conditions above). The differences in pre-conditioning conditions for the control versus the treatment product were required to achieve the desired external product color upon exiting the impingement oven.

Control Finished Color



Treatment Finished Color



Conclusions

Minolta L values for control products were 56.31 vs. 54.65 for treated fillets. The L values were not significantly different. In addition, the surface texture of the treated fillets was deemed to exhibit a more desirable oven-baked /skin-like appearance versus the mottled surface and puffy texture observed in control fillets. The more desirable skin-like appearance of the treated product is a result of surface proteins cross-linking (creating a tighter barrier to seal moisture within the product) attributed to the six-seven seconds of drenching with RA03036.

The topical drenching of chicken breast fillets with a 15% concentration of Red Arrow Browning Agent RA03036 resulted in a significant 5.57% increase in cooked product yield. Pre-conditioning ovens were operated 6.25% cooler (425°F versus 400°F) and throughput time was 25% faster (60 seconds for control fillets versus 45 seconds for treated fillets). Impingement oven operating conditions for treated fillets were 11.42% faster versus control fillets (420 seconds versus 468 seconds respectively).

In addition, the test product with RA03036 Browning Agent was cooked in the impingement oven at a significantly higher Relative Humidity (80% vs 11%) compared to control product. This aided in yield enhancement and decreased cooking time to reach required internal temperature.

The application of a 15% concentration of RA03036 generated golden brown highlights, uniform surface color and a desirable surface texture while increasing cooked product yield values by 5.57%. No ingredient labeling is required when RA03036 is applied topically to USDA regulated products followed by thermal cooking conditions..

The improvement in cooked product yield for treated fillets is thought to be directly influenced by three key attributes:

1. The milder (cooler) conditions established in the pre-conditioning oven (6.25% lower operating temperature with 25% faster throughput).
2. The cross linking of surface proteins facilitated by the drenching of RA03036 Browning Agent.
3. Ability to operate the impingement oven 11.42% faster (control fillets required 468 seconds versus treated fillets at 420 seconds), coupled with higher humidity conditions expressed as percentage moisture to volume ratios, 11% actual for control versus 80% for treated fillets.