Enrobing: an innovative way of improving sensory and storage quality of foods of animal origin

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Abstract

Enrobing is the process of applying edible coatings on the processed products to improve its aesthetic value and storage life. The process of enrobing is popular since Mesolithic era with the use of wax to enrobe the fruits and vegetable for the reduction of rate of moisture loss and release of gases. Various coating materials such as proteins (plant and animal sources), polysaccharides (cellulose, starch and their derivatives, chitosan, alginate, gums etc.) and lipids (bee/carnauba/candelilla/paraffin/polyethylene wax, fatty acids and monoglycerides, etc.) were explored for different processed plant and animal derived foods. The different methods of enrobing include single and double pass system, batter fry system tempura-Japanese. Enrobing improves process, sensory and storage quality attributes of the product. It acts as a delivery vehicle for carrying antimicrobial and antioxidant substances for the extension of storage life of the food products. Enrobing can be successfully employed to add value to products and to develop a low calorie fried products.

Keywords: Enrobing, storage quality, enrobed meat products, sensory quality

Introduction

Enrobing/Edible coating is a process in which foods were traditionally coated with edible coating materials in the form of batter to provide the processors an opportunity to prepare value added meat products while preserving and enhancing their quality (Garg and Mendiratta, 2006). ‘Further processed products’ can be prepared by applying edible coating on the products in two distinct steps i.e. battering and breading (Ahamed et al., 2007).

Enrobing/coating with wax on the fruits like oranges and lemon to retard desiccation has been documented long back in China in the 12th and 13th centuries (Herdenburg, 1967). Enrobing of foods with fat, a practice called ‘larding’ was used in 16th century in England with the objective to slow the rate of moisture loss from the product (Labuza and Contreras-Medellin, 1981). Preservations of meat and other food stuffs by coating them with gelatin films was proposed by Havard and Harmony (1869) and by Morris and Parker (1895). In the 1930s hot melt paraffin waxes became commercially available for coating citrus fruits to retard moisture loss and whereas in the early 1950s, carnauba wax oil-in-water emulsion was developed for coating fresh fruits and vegetables (Kaplan, 1986).

Over past few years considerable work, reported in both scientific and patent literature, has been done on the use of edible films and coatings to extend shelf life and improve the quality of fresh, frozen and fabricated foods. A variety of polysaccharides, proteins and lipids have been utilized, either alone or in mixture, to produce composite films or coatings (Table 1)

Materials of enrobing/edible coating

Various coating materials studied for preservation, extending shelf life and to improve the quality of meat and meat products and vegetables:

1. Protein based coatings: Corn zein, wheat gluten, milk proteins, soya proteins, collagen, gelatin, keratin, peanut protein.
2. Polysaccharide based coatings: Cellulose and derivatives, starch and derivatives, chitosan, alginate, pectin, carrageenan, gum arabic, gellan gum etc.
3. Lipid and resin based coatings: Bee wax, carnauba wax, candelilla wax, paraffin wax, polyethylene wax, fatty acids and monoglycerides, shellac etc.
Attempts have been made to enrobe the product by using economical coating materials viz., pectin and bengal gram (Chidanandaiah and Keshri, 2007), bengal gram and rice flour (Chidanandaiah and Keshri, 2006). Raut et al. (2011) worked on the effect of batter consistency as enrobing on the quality of chicken patties and concluded that batter ratio of 1:1.3 containing bengal gram flour and water is good in terms of sensory and physico-chemical characteristics. Various types of edible coatings and films have been reported on the application in fried food, including methylcellulose (Albert and Mittal, 2002; Nasiri et al., 2010), corn zein (Mallikarjunan et al., 1997), hydroxypropyl methylcellulose (Holownia et al., 2000), dextrin and dried egg (Baixauli et al., 2003) and chitosan (Usawakesmanee et al., 2005; Lin and Chao, 2001). The ability of these coatings to reduce moisture transfer may enable fried food products to maintain their crispiness by inhibiting moisture transfer from the food material to the crust and by limiting moisture absorption from the environment into the crust. In addition, these coatings set around the piece of food on heating/frying and in turn leading to improved crispiness of the product. The list of enrobed livestock products are presented in Table 2.

Methods of enrobing

Foods can be enrobed in many ways in order to provide acceptable adhesion or desired texture and functional properties. Automated systems for enrobing chicken parts have been designed to duplicate hand operation. The different methods of enrobing are:

1. **Single pass system**: This method batters and breads the product only once and even with a pre-dust, coating pickup is around 30%.
2. **Double pass system**: The system repeats the process of batter and breading and coating pickup can range from 30-50%.
3. **Batter fry system**: In this method, a dry pre-dust followed by enrobing the food in a viscous batter and coating pickup can vary from 30-50%.
4. **Tempura-Japanese**: In this method food is enrobed with a tempura batter and coated with Japanese breading. Coating pickup can range from 36-55%.

Benefits of enrobing

Enrobing has multifaceted benefits on processing, sensory and storage quality of the product. In addition, it may act as delivery vehicle for carrying the bioactive compounds required for the improvement of the quality attributes of the product. The common benefits from enrobing are detailed below:

1. **Processing quality**: Enrobing removes the monotony of food products and makes them more attractive in appearance and adds to better taste (Elston, 1975; Biswas, 2002). Edible film and coating produced from polysaccharides, protein and lipid derivatives can function as efficient barriers to moisture, oxygen or reducing oil uptake in product (Krochta and De Mulder-Johnston, 1997; Wu et al., 2000). Enrobing provides processors with added value product at low cost.
2. **Sensory quality**: Enrobing also improves the colour, crispiness, flavour, juiciness, nutritive value of the product. (Cunningham, 1989). Further, Breading on the fried meat enhances texture, flavour and appearance of the product (Rao and Delaney, 1995).
3. **Storage quality**: Enrobing also plays an important role in the improvement of physico-chemical and microbiological quality of the product and thus enhances the shelf life of the product. Enrobing materials have been used as carrier for various antimicrobial and antioxidant substances (Pszczola, 2002; Biswas et al., 2004, Yadav and Sharma, 2008). This approach can be used to impart a strong localised functional effect without elevating excessively the overall concentration of an additive in the food (Guilbert et al., 1985).

Microbiological quality of enrobed products

Microbiological quality is essentially required to deal with the food safety issues, legal and consumers’ requirements. Several scientists documented that the enrobing reduces the microbial load and prevent post processing contamination (Anand et al., 1991; Ahamed et al., 2007). The microbiological count of 4.6 log cfu/g for psychrophilic and 5.33 log cfu/g for total plate count (TPC) is considered to be indicative of the unacceptability of cooked meat products (Cremer and Chipley, 1977). Yadav and Sharma (2008) found significantly lower microbial growth in enrobed chicken patties than control at the 28th day of storage.

Reddy et al. (1990) reported that fish finger contained higher aerobic counts after breading and battering than control, however it decreased significantly on frying. The psychrophilic bacteria, yeast and moulds were detected occasionally but were in-significant in numbers. Though, mesophilic count in enrobed buffalo meat cutlet followed an increasing trend during storage but it was significantly lower than control (Ahamed et al., 2007). Throughout storage, mesophilic counts were within the established standard...
Table 1: Various enrobing materials used in meat and meat products

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Enrobing/Coating material</th>
<th>Meat/ Meat Products</th>
<th>Benefits</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Starch + alginate tocopherol</td>
<td>Beef patties</td>
<td>Reduced lipid oxidation and warmed over flavour</td>
<td>Hergens-Madsen et al., 1995</td>
</tr>
<tr>
<td>2.</td>
<td>Corn zein</td>
<td>Precooked turkey breast slices</td>
<td>Reduced warmed over flavor</td>
<td>Herald et al., 1996</td>
</tr>
<tr>
<td>3.</td>
<td>Starch + alginate rosemary</td>
<td>Precooked pork chops</td>
<td>Reduced warmed over flavor and lipid oxidation</td>
<td>Handley et al., 1996</td>
</tr>
<tr>
<td>4.</td>
<td>Hydroxypropyl methylcellulose</td>
<td>Chicken balls</td>
<td>Moisture retention up to 16.4% and fat reduction up to 33.7%.</td>
<td>Balasubramaniam et al., 1997</td>
</tr>
<tr>
<td>5.</td>
<td>Wheat gluten, soy protein, carrageenan, and chitosan</td>
<td>Precooked beef patties</td>
<td>Reduced lipid oxidation and moisture loss</td>
<td>Wu et al., 2000</td>
</tr>
<tr>
<td>6.</td>
<td>Gram flour, refined wheat flour, egg white</td>
<td>Spent hen enrobed chunks</td>
<td>Improved sensory attributes</td>
<td>Mendiratta et al., 2002</td>
</tr>
<tr>
<td>7.</td>
<td>Carboxymethylcellulose</td>
<td>Pork patties</td>
<td>Moisture barrier, improved sensory attributes</td>
<td>Biswas et al., 2004</td>
</tr>
<tr>
<td>8.</td>
<td>Methylcellulose</td>
<td>Squid rings</td>
<td>Less fat absorption and more moisture retention</td>
<td>Sanz et al., 2004</td>
</tr>
<tr>
<td>9.</td>
<td>Egg white powder</td>
<td>Buffalo meat cutlets</td>
<td>Moisture barrier</td>
<td>Ahamed et al., 2007</td>
</tr>
<tr>
<td>11.</td>
<td>Pectin and Bengal gram flour</td>
<td>Buffalo meat patties</td>
<td>Moisture and fat uptake barrier</td>
<td>Chidanandaiah and Keshri, 2007</td>
</tr>
<tr>
<td>12.</td>
<td>Rice flour, refined wheat flour, carboxy methyl cellulose, guar gum</td>
<td>Chicken patties</td>
<td>Moisture and fat uptake barrier, reduced lipid oxidation</td>
<td>Yadav and Sharma, 2008</td>
</tr>
<tr>
<td>13.</td>
<td>Bengal gram, corn flour with and without Sodium alginate and CMC</td>
<td>Spent hen meat patties</td>
<td>Retention of moisture and reduce fat uptake and shear force values</td>
<td>Rajnish et al., 2008</td>
</tr>
<tr>
<td>14.</td>
<td>Chitosan</td>
<td>Silver carp</td>
<td>Extended shelf life, improved sensory attributes</td>
<td>Wenjiao et al., 2009</td>
</tr>
<tr>
<td>15.</td>
<td>Bengal gram flour</td>
<td>Chicken patties</td>
<td>Moisture and fat uptake barrier</td>
<td>Raut et al., 2011</td>
</tr>
</tbody>
</table>

Table 2: List of few enrobed livestock products

<table>
<thead>
<tr>
<th>Meat products</th>
<th>Pork patties, beef patties, pork and beef nuggets, buffalo meat cutlets, goat meat bites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poultry products</td>
<td>Precooked cutup poultry parts, raw cutup poultry parts, chicken patties, nuggets</td>
</tr>
<tr>
<td>Sea foods</td>
<td>Coated shrimp, natural and formed fillets, fish sticks, squid rings</td>
</tr>
<tr>
<td>Egg products</td>
<td>Egg bonda</td>
</tr>
<tr>
<td>Dairy products</td>
<td>Paneer, cheese nuggets, cheese sticks and cubes etc.</td>
</tr>
</tbody>
</table>

(Cunningham, 1989)
enrobed buffalo meat cutlet followed an increasing trend during storage but it was significantly lower than control (Ahamed et al., 2007). Throughout storage, mesophilic counts were within the established standard limits for enrobed foods (log 4 cfu/g) (Wehr, 1978). Chidanandaiah (2003) reported similar observations for enrobed buffalo meat patties stored at refrigeration temperature. Naveena (2002) observed increases in TPC values of roasted buffalo meat chunks, from 1.19 ± 0.04 on the 7th day to 2.03 ± 0.03 log10cfu/g on the 28th day of storage. Jairath (2013) also observed lower standard plate count in enrobed goat meat bites as compared to control and on day 35th of storage, the SPC counts of control was 5.34 ± 0.01, whereas, it was 3.49 ± 0.01 for enrobed product.

**Sensory attributes of enrobed products**

Many researchers postulated the effect of different ingredients of batter mix and enrobing materials on the sensory quality attributes of different products. They have reported that enrobing not only improves the sensory attributes such as general appearance, colour, flavor and juiciness of the product but also help in maintenance of these attributes during storage in air permissible films due to its protective cover. Hanson and Fletcher (1963) reported that batter mix containing equal part of corn starch, waxy corn starch and yellow corn starch flour yielded promising results on all sensory attributes viz. general appearance and colour, adhesiveness, flavour, thickness and crispiness. Wanstedt et al. (1981) reported that alginate-coated precooked, frozen stored pork patties had improved sensory qualities and were more desirable than control. Wu et al. (2000) reported that enrobed pork chops and beef patties were juicier than uncoated frozen stored samples and found that colour values of coated products decreased with storage due to release of moisture from the coating. The results of appearance and colour scores were in agreement with the findings of Naveena (2002) who reported significant (p<0.01) decrease in same pattern of buffalo meat chunks during storage for 28 days at 4±1°C.

**Carrier of bioactive compounds**

Many scientists reported the role of enrobing as a carrier for various synthetic or natural antimicrobial and antioxidant substances (Shelef and Liang, 1982; Giridhar and Reddy, 2001; Formanek et al., 2001; Pszczola, 2002). Biswas et al. (2004) successfully employed like butylated hydroxytoluene and butylated hydroxyanisole in enrobed pork patties and reported that shelf life of enrobed pork patties incorporated with synthetic antioxidant is more than 28 days. Yadav and Sharma (2008) incorporated nisin and tocopherol in the edible coatings of rice flour. Jairath (2013) also employed enrobing material (25% liquid egg white) as a carrier of natural antioxidants like apple peel extract and crude aloe vera gel and product was found palatable even on day 42 with respect to physico-chemical and sensory attributes.

**Conclusions**

Enrobing can be successfully employed to add value to products and to develop a low calorie fried products. Enrobing improves not even the sensory attributes of the products but also the physico-chemical, microbiological attributes of the products and therefore, satisfies the consumers’ need in every aspect. In addition, it can be successfully used as a carrier of bioactive compounds. The Production of enrobed products with improved sensory attributes, microbiological qualities may find their entry into global markets and fetch higher returns. The future success of enrobed products in India depends on how well industry partners and R and D Institutions join hands for meaningful partnership which would definitely benefit producers, processors and consumers.

**References**


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