

Review Article

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## Utilization of Spent Hen in Food Industry- A Review

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### ABSTRACT

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The demand for convenience meat products is increasing globally due to rapid urbanization, changing lifestyles, increased per capita income, socio-economic status and awareness about hygiene, nutritional, satiety and palatability characteristics. Meat being perishable food requires considerable input for chilling or freezing during storage and marketing which demand continuous energy supply. Spent hen meat, an excellent and cheaper source of animal protein can be effectively use for processing of convenient and self stable products for under developed and developing countries suffering serious protein energy malnutrition. Development of technologies for production of low-cost, safe and acceptable shelf stable spent hen meat products is need of the hour. The review is intended to provide an overview of the present status of the utilization of spent hen meat.

### Introduction

Hens that have completed their laying cycle within one year are referred to and marketed as spent hen (Haque *et al.*, 1991). Spent hens are considered as byproduct of egg industry (Mahapatra, 1992) which is rich in fat and cholesterol content, and poor in functional characteristics, juiciness and tenderness due

to high collagen content (Abe *et al.*, 1996) and high degrees of cross linkages (Wenham *et al.*, 1973; Bailey, 1984) as compared to broiler meat. In spite of being similar nutritional quality of broiler meat (Chueachaychoo *et al.*, 2011), spent hens have minimal economic values (Baker *et al.*, 1968; Mahapatra, 1984).

The layer bird population of India was around 247 million in 2010 (Juse, 2012). With the rapid growth of poultry production, number of spent hens has also increasing. If the volume of biological matter, labor, and associated transportation costs are taken into account, the disposal of layer hens is one of the important economical and environmental problems of the poultry industry (Lyons, 2001). In addition, with the increase of broiler production, the sale of spent breeding hens at reasonable prices has become more difficult, affecting producers' profits (Kondaiah, 1993).

The moisture, protein, fat and total ash content of spent hen meat is 67.46, 24.36, 7.15 and 1.04 %, respectively (Lee *et al.*, 2003). Spent hen meat is a good protein source (Lee *et al.*, 2003), highly enriched with omega-3 fatty acids and lower in cholesterol content particularly breast muscle which has health promoting benefits. Chicken fat contains 67% unsaturated fatty acids (MUFAs and PUFAs) compared to beef (42%), pork (57%) and lamb (46%) (Hedrick *et al.*, 1993). Spent hen meat is more prone to oxidation than broiler during processing and storage due to higher fat content consisting of high content of unsaturated fatty acids. Over last few years demand for poultry meat is growing because it is an excellent and cheaper source of animal protein food associated with low fat and low calorie food (Akiba *et al.*, 2001). Effective utilization of layer birds after the end of their productive life is one of the urgent requirements of Indian poultry industry as 30 percent of the poultry slaughtered are spent hens (Juse, 2012).

Spent hens are usually used in feed production, concentrated stock preparations, or in domestic consumption of soups and stews (Ajuyah *et al.*, 1992; Voller-Reasonover *et al.*, 1997). To offer an alternative for spent hen, the hurdle technology described by Leistner and Gorris

(1995) has been introduced to process breast and thigh of spent hen meat. With breast and thigh meat samples of White Leghorn spent hen was preserved following hurdle measures using salting plus antioxidants, drying, and vacuum packaging. (Rocha Garcia *et al.*, 2003).

### **Convenience foods**

The demand for quality meat and meat products is ever increasing among quality conscious consumers due to growing awareness about hygiene, nutritional, satiety and palatability characteristics. Growing urbanization coupled with new pressures on the times of house wives, increasing number of women entering job, changing lifestyles, increased per capita income, consumer awareness and socio-economic status have also contributed to the enhanced consumption of processed and convenience meat products ready-to-eat, heat and serve convenience meat products (Kumar *et al.*, 2001; Deogade *et al.*, 2008). Convenience foods are classes of foods which impart convenience to the consumers as it require little or no major processing or cooking before consumption. Convenience foods just require mild heating/warming for ready-to-reconstitute or ready-to-eat products or rehydration in hot/cold water for dehydrated foods (Premavalli, 2000). A wide spectrum of ready-to-eat and instant convenience mixes which find an immense use and application not only in defense but also in civilian sector includes precooked dehydrated convenience foods and instant convenience foods (Sharma and Bawa, 2003).

### **Shelf stable meat products**

Meat being a nutritious food it is also perishable which require considerable input for chilling or freezing during storage and marketing of meat and meat products. Meat is a favourable medium for the growth of

microorganisms due to its high water activity, high levels of nutrients especially protein and neutral pH. High perishability of meat and meat products is a serious problem in tropical countries like India. The scarcity of meat leads to the shortage of supplies in developing countries. This valuable food is spoiled readily unless held at chilling temperature and problem becomes more acute where cold storage facilities are absent in retail sector. One of the primary objectives of food processing is the conversion of perishable foodstuffs into shelf stable products. Preservation of meat either in fresh or in processed form requires considerable energy (Gadekar *et al.*, 2010). Thus development of shelf stable foods is in high prerequisite to distribute it without refrigeration facility to various locations. Based upon various preservation techniques the meat products may be shelf stable like cured and canned products, snack type products, dry and intermediate meat products, meat powder etc.

### **Comminuted products**

Improved deboning techniques and modern methods of meat processing could enhance the quality and value of spent hen meat leading to greater demands and better financial returns (Kondaiah and Panda, 1992). Different tenderizing agents were used to tenderize of spent hen meat (Mendiratta *et al.*, 2004). Since spent layers are very cheap source of meat it can be used successfully in the formulation of many value added meat products (Kim and Ahn 1997). Poultry meat based products such as patties, sausages, nuggets, kabobs, samosa, etc. have substantial potential in western as well as in eastern countries (Patnaik, 1993). In India lot of potential exists for development of such processed products, though at present less than one percent of meat is being processed.

Development of comminuted meat products offers an important avenue for the profitable

disposal of spent hens (Prabhakar Reddy and Srinivasarao, 1997). Utilization of meat from spent hen through further processed products has been attempted by several workers (Seideman *et al.*, 1981). Addition of meat from different parts of spent chicken especially breast and leg muscle increased the quality of chicken nuggets (Mahapatra and Verma, 1998). Meat from spent bird is inferior compared to the broiler meat and can effectively be utilized by developing value added products (Rongsensusang *et al.*, 2005). Spent hen meat can be utilize in sausage manufacture, since its hardness is not an obstacle for the production of most processed products, which use ground meat (Kondaiah and Panda, 1992). Utilization of semi heavy spent hen meat has potential for manufacture of mortadella-type sausages with vegetable oil (Souza *et al.*, 2011).

Use of spent hen meat with substantial amounts of non-meat ingredients reduces undesirable characteristics of these meat in final products because of the inherent nature of the processes involved, or ingredient interactions during processing (Rhee *et al.*, 1999). The sensory parameters and protein content of culled hen and broiler breeder male meat tikkas are influenced by binders, storage period and cooking (Sekhon and Bawa, 1991). Spent hen meat loaf extended with lentil flour had significantly more flavour and overall acceptability scores and lower tenderness scores than loaf extended with black gram flour and maida (Sachdev *et al.*, 1996). Incorporation of caseinates and refined wheat flour in spent hen meat nuggets improves sensory scores (Rao *et al.*, 1997). Incorporation of 1% sodium caseinates into the spent hen meat nuggets significantly improves the colour, flavour, juiciness, texture and overall acceptability scores than addition with 2% sodium caseinate or 1 and 2% calcium caseinates (Singh *et al.*, 1997). General appearance, flavour, juiciness and texture of spent hen meat nuggets is affected

with the level of incorporation of rice flour (Nag *et al.*, 1998). Raw spent hen meat sausages was superior for appearance, flavour, juiciness, firmness and overall acceptability than sausages incorporated with skin, gizzard, heart and yolk (Prabhakara Reddy and Vijayalakshmi, 1998). Incorporation of skin (18-21%) and giblets (12-14%) in spent hen meat patties improve juiciness, tenderness and overall acceptability scores (Lingaiah and Prabhakara Reddy, 2001). Incorporation of any dried egg products except dried yolk significantly improved the appearance, colour and flavour scores of spent chicken meat patties (Kalaikannan *et al.*, 2007). Incorporation of egg and potato in spent chicken meat nuggets leads to higher moisture content in products (Kondaiah *et al.*, 1990).

### **Restructured products**

Meat from spent birds is generally tough, dry and sinewy (Mediratta *et al.*, 2004). Value enhancement of raw materials, portion control, uniform quality and consumer convenience are some of the advantages of restructured meat products. Products that undergone particle size reduction such as sectioning, chunking, slicing, flaking, blade tenderization, chopping followed by forming into steaks, roasts or patties are called restructured meats (Hedrick *et al.*, 1994). Restructured meats can be bounded together through the formation of gel that is thermally set (Boles and Shand, 1999). Conventional restructured meat products using salt and phosphates depend on the thermal binding of myofibrillar proteins that are extracted from meat (Mandigo, 1986). In this perspective, it is necessary to evolve appropriate technology to convert the tough and less palatable spent hen meat in to convenient, attractive and more acceptable novel products. Restructured spent hen meat nuggets from spent hen meat emulsion is moderately to highly acceptable whereas from ground spent hen meat batter is

moderately acceptable (Anna Anandh and Annal Villi, 2018). Restructured chicken steaks extended with texturized soy flour and milk co-precipitates improves color, texture, juiciness and overall acceptability (Bhoyar *et al.*, 1997).

### **Drying**

Drying is one of the oldest methods of food preservation and a very important aspect of food processing (Vadivambal and Jayas, 2007). It is the process of simultaneous heat and mass transfer operation in which water activity of a material is lowered by the removal of water (Kharaisheh *et al.*, 1997) and thereby enabling microbial stability and consequent extension of shelf life of the product without compromising the desired attributes. Growing resistance to the use of chemicals for food preservation, and the demand to provide a comprehensive range of products, has led to a renewed interest in drying operations (Jayaraman *et al.*, 1992). Dried meat products can be prepared by different methods, sun drying being the simplest and cheapest method of drying. However, it is a time consuming process and exposes meat to contamination from air that contains aerosolized microbes, insects, dust etc. The drawbacks can be reduced to an extent by drying meat in mechanical dryers or solar dryer.

Dried foods contain less than 25% moisture and a water activity less than 0.60 whereas intermediate moisture foods products contain between 15 and 50% moisture and a water activity between 0.60 to 0.85 (Jay *et al.*, 2005). The advantages of dried products are requirement of less storage space, ease of transport and non-requirement of cold chain facilities. Dried meat and meat products are rich in protein and serve as nutrient dense foods especially to malnourished people in under developed and developing countries.

### **Spent hen meat powder**

Spent hen meat powder is one of the best options to produce the shelf stable meat product. Powdered meat extracts are widely used by the food industry to provide flavour to snacks and instant sauces (Varnam and Sutherland, 1995). Although the gelling functionality of meat proteins is generally regarded to be greatly reduced after dehydration (Mackie, 1994), the cost saving benefits could still make meat powders attractive to the food industry as a substitute for raw meat ingredients. Chicken meat powder has been used in developing chicken enriched noodles to improve the nutritional quality of the products (Kumar, 2009).

Converting spent hen meat into meat powder increases its shelf life without substantial loss of quality, even at ambient temperature. Spent hen meat powder technology is useful in situations of low prices due to poor demand and disease scare situations like bird flu outbreak.

Value addition and effective utilization of the spent hen meat can be enhanced by processing the spent hen meat powder into ready-to-use convenience products. Besides, millions of people worldwide especially in under developed and developing countries suffer from serious protein energy malnutrition problem, due to acute shortage of animal protein in the diet.

To meet these demands, effective utilization of spent hen for the development of meat powder would not only provide scope for formulation of value added products but also supply protein-rich nutrients to the consumers.

### **Chicken soup**

Soup is probably one of the oldest foods of human being, since it must have developed

about the time when boiling was establish as very fast form of cookery. It is simple to prepare, relatively cheap, nutritious, easily digestible and highly cherished by young generation. Chicken soup is prepared by boiling the ingredients such as meat, vegetables and starch in hot water, until the flavour is extracted, forming a broth. For instance, it is regarded as the most ubiquitous medicinal soup in the world. Chicken soup has long been regarded as a remedy for symptomatic upper respiratory tract infections. Sipping warm soup can clear nasal passages, serving as a natural decongestant, which also relieves cold and flu symptoms. Chicken soup might have anti-inflammatory activity, namely, the inhibition of neutrophil migration (Barbara *et al.*, 2000) and could hypothetically lead to temporary ease from symptoms of illness (Rennard *et al.*, 2000). Normally soups are consumed before meals to stimulate the appetite and flow digestive juices in stomach. Chicken soup is often referred as “Jewish penicillin”, “bohbymycetin” and “bobamycin” (Caroline and Schwartz, 1975; Saketkhoo *et al.*, 1978).

Studies have been conducted on different types of chicken soup like chicken whey soup (Chidandandiah and Sanyal, 2001), chicken soup (Shukla *et al.*, 2014) and instant soup mix (Gokulakrishnan, 2014). Spent hen meat being a good protein source, highly enriched with omega-3 fatty acids, lower cholesterol content and health promoting benefits (Chueachuaychoo *et al.*, 2011) may successfully utilize in soup preparation.

### **Instant soup mix**

Dry soup mixes are well recognized convenience food item in the world food markets. Instant soup mixes are preferred more as dry soup mixes by consumers because of their convenience in preparation, shelf stability and excellent appetizing property. According to various estimates,



soup market in India was in the range of INR 100-125 crores in 2010 (Juse, 2012). The category of ready to cook soup mixes formed 25 percent of the instant food segments (Juse, 2012). The major brands in ready to cook soup mixes in Indian market are Knorr (Hindustan Uniliver), Maggi (Nestle), Ching's secret (Capital Foods), Bambino (Bambino Agro), Sil (Scandin Food), Campbell's (Weikfield Products) etc.

Instantly cookable dry soup mix was prepared from a mixture of powdered dried stock containing several dried ingredients (Kaisha, 1979; Gokulakrishnan, 2014), in which meat extract was used in dried stock and the process involved was concentration. Harris and Davis (1993) prepared a dry soup mix by mixing dry edible components and the process involved use of hydrolyzed chicken protein and chicken flavourings.

Canned soup prepared from fresh chicken was not in dehydrated form and canning is required for storage and presentation (Deping *et al.*, 2001). Hiroyuki (2002) reported a method for producing the chicken soup stock in which chicken extract was used for making soup and the process involved vacuum condensation. Deboning and mincing the pressure cooked meat during preparation of chicken soup, increases the chance of post-cooking microbial contamination and further cooking of meat with bone increased the fat content of the final product (Sachindra *et al.*, 2007).

### **Snack foods**

Consumers are highly cherished by snacks due to its convenience nature and overwhelming taste and flavor. Due to high nutritive value and superior sensory qualities, a broad range of snacks from plant and animal origins are consumed and sold under various geographical indications. The present global

trends and lifestyle factors are currently driving the snack food industry and some of these factors are changing and extended working pattern, increasing number of single person households, different eating times and food choices by individual family members and increasing perception of food as a reward (Gokulakrishnan, 2014).

Snack foods being convenient food items are most suitable for working women, school age children and highly mobile population (Lusas and Rhee, 1987). Snacks have become one of the major groups of the functional food products in diet (Roberts, 2002) which can serve the purpose of healthy food, entertaining and tasty food and ethnic cuisines of consumers (Anon, 1998). Snack food products include extruded snacks, puffed cereals, popcorns, rice flakes, potato chips, french fries and Indian home made products like *papads*, *kurdai*, *chakali* etc. which may be consumed after frying or roasting (Nath *et al.*, 2007). These foods are prepared from natural ingredients to yield products with specified functional properties, have become an integral part of the eating habits of majority of world's population (Reid, 1998). Meat incorporation improves flavour, taste and nutritive value of the products. Several meat based snacks like curls, chips and samosa had been developed by Sharma and Kondaiah (2005). Spent hen meat powder incorporated *papad* (Gokulakrishnan, 2014) and *bhujia* (Talukder *et al.*, 2015) were found self stable with high sensory acceptance during ambient storage for 60 days and 45 days respectively.

In conclusion, spent hens are considered as byproduct of egg industry which is rich in fat and cholesterol content, and poor in functional characteristics, juiciness and tenderness. Effective utilization of spent hen meat is one of the urgent requirements of Indian poultry industry. Spent hens are

usually used in feed production, concentrated stock preparations, or in domestic consumption of soups and stews. Millions of people worldwide especially in under developed and developing countries suffer from serious protein energy malnutrition problem, due to acute shortage of animal protein in the diet. Being a good protein source it can be effectively used for production of different convenient and self stable products. Though some studies were carried out by different researcher for production of comminuted, restructured, dried, canned, soup or snacked products from spent hen meat, but commercially yet to be popular such products. The further technological developments in production and processing of spent hen meat products can fetch extreme popularity in coming future.

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