Quality Evaluation of Chicken Nugget Formulated with Various Contents of Chicken Skin and Wheat Fiber Mixture

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Abstract

This study aimed to investigate the effects of various mixtures of the chicken skin and wheat fiber on the properties of chicken nuggets. Two skin and fiber mixtures (SFM) were prepared using the following formulations; SFM-1: chicken skin (50%), wheat fiber (20%), and ice (30%); and SFM-2: chicken skin (30%), wheat fiber (20%), and ice (50%). Chicken nugget samples were prepared by adding the following amounts of either SFM-1 or SFM-2: 0%, 2.5%, 5%, 7.5%, and 10%. The water content for samples formulated with SFM-1 or SFM-2 was higher than in the control (p<0.05), and increased with increasing the concentrations of SFM-1 and SFM-2. The addition of SFM-1 and SFM-2 had no significant effect on the pH of the samples. The lightness value of uncooked chicken nuggets was higher than that of cooked chicken nuggets for all the samples tested. Chicken nuggets formulated with SFM-1 and SFM-2 displayed higher cooking yields than the control sample. The hardness of the control sample was also lower than the samples containing SFM-1 and SFM-2. The sensory evaluation showed no significant differences between the control and the samples containing SFM. Therefore, the incorporation of a chicken skin and wheat fiber mixture improved the quality of chicken nuggets.

Key words: chicken, nugget, skin, dietary fiber

Introduction

Chicken nuggets, a chicken products made usually from chicken breast, is a very common type of food, especially in Korea where chicken nuggets are served at large-scale catering. The surface appearance and texture of a nugget are the most significant factors for consumer acceptability. Most nuggets cook rapidly and develop a golden color, crisp texture, and good flavor at frying temperatures between 160 and 190°C. Instrumental measurement of the texture and color can offer a quantified basis for controlling the frying times and temperature for quality control and improvement. In general, a fried food becomes tougher when its frying time increases beyond an optimum value. The amount of moisture lost during frying generally decreases exponentially with frying time because of mass transfer during the frying process owing to moisture loss and oil absorption. Costa and Oliveira (1999) reported that predicting water loss was critical for modeling and controlling the deep fat frying of potatoes. Interestingly, almost no oil penetrates the food during the frying process; instead, the majority of oil is absorbed by the fried food during the cooling period after it is removed from the fryer (Gamble et al., 1987; Moreira et al., 1995). Fried nuggets often contain a large quantity of oil and fat. However, consumer demand for low-fat and low-calorie products has been increasing, because the consumption of high animal fat content (especially saturated fatty acids and cholesterol) is correlated to an increased incidence of obesity, hypertension, cardiovascular disease, and coronary heart disease (Ozvural and Vural, 2008; Vural and Javidipour, 2002). Consumers prefer low-fat meat products with good flavor (Lin and

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Huang, 2008). The trend toward low-fat and low-calorie food has led the meat products industry to develop or modify traditional food products containing less animal fat (Bloukas and Paneras, 1993; Garcia et al., 2002; Mittal and Barbut, 1994). Consistent with this trend, manufacturers have reduced the fat content of chicken nuggets, typically by using the dietary fiber and chicken skin.

Chicken skin, a by-product of the chicken meat, production process, is a potential water binder and texture-modifying agent for use in reduced-fat meat products. Improving the functionality (solubility) of chicken skin may increase its potential for use in meat products as a less expensive water binder or texture-modifying agent. Mechanical modification (Eilert and Mandigo, 1993), heating (Sadler and Young, 1993), and a combination of factors such as pH, salt, phosphates, and water (Park et al., 2013; Puolanne and Ruusunen, 1981) have been employed to improve collagen solubility in chicken skin. Bönifer et al. (1996) reported that the removal of fat from chicken skin using sodium bicarbonate increased the protein content in bologna sausage.

Dietary fibers have been added to a range of meat products to improve the functional and rheological properties of the mat products (Choe et al., 2013; Choi et al., 2009). Kim et al. (2012) reported the addition of wheat fiber to semi-dried jerky to enhance its quality characteristics such as texture and drying yield. In addition, several studies have shown that dietary fiber can be used to improve the physicochemical properties of jerky, sausages, meat balls, and hamburgers (Choe et al., 2013; Crehan et al., 2000; Hughes et al., 1997; Jiménez-Colmenero, 1996; Kim et al., 2012; Mansour and Khalil, 1999; Nuria et al., 1999; Thebaudin et al., 1997). This study was conducted to assess the effect of chicken skin and wheat fiber mixtures (SFM) as a replacement for chicken skin on the quality properties of a chicken nugget, including proximate composition, cooking yield, pH, color, texture profile, and sensory evaluation.

Materials and Methods

Materials

The chicken breast and skin were provided by Maniker F&G Co., Ltd (Yongin, Korea). The subcutaneous fat and visible connective tissue were completely removed from the chicken breast and skin. The chicken breast and skin (2-3 kg) was then placed in polyethylene bags, vacuum packaged using a vacuum packaging system (FJ-500XL, Jujee Tech, Korea), and stored at -21°C until required for product preparation. The fiber used was wheat fiber Vita-cel® (J. Rettenmaier & Söhne GmbH, Germany). This fiber consists of 74% cellulose, 26% hemicellulose and <0.5 of lignin; WF400 with 500 µm long particles. All reagents were of analytical grade. All the experiments were performed in duplicate with at least three replicates. The results were expressed as the mean and standard deviation.

Preparation of chicken skin and fiber mixture

Suitable amounts of the chicken skin were tempered at 4°C for 4 h prior to preparing the chicken skin and fiber mixture. Two skin and fiber mixtures (SFM) were prepared with the following formulations: SFM-1: chicken skin (50%), wheat fiber (20%), and 30% ice (30%); and SFM-2: chicken skin (30%), wheat fiber (20%), and ice (50%). Two batches of SFM-1 and SFM-2 were prepared for each treatment. For each batch of the chicken skin, wheat fiber and ice were emulsified using a silent cutter (Nr-963009, Germany). Immediately after cutting, the SFM samples were stored in dark at 4°C until required for product manufacture.

Chicken nugget preparation and processing

Suitable amounts of the chicken breast and chicken skin were tempered at 4°C for 24 h prior to nugget batter preparation. The chicken breast and skin were initially ground through an 8 mm plate. Nine different nugget batters (each 5 kg) were produced; the experimental design and compositions are shown in Table 1. The binder chicken breast was homogenized and ground for 1 min in a silent cutter (Nr-963009, Germany), followed by cooling it in an iced water (2°C), 0.5% NaCl and 0.3% sodium tripolyphosphate were added to the binder chicken breast and mixed for 1 min. The chicken skin and SFM were added after 3 min, and the batter was homogenized for 6 min. A temperature probe (Kane-May, KM330, Germany) was used to monitor the emulsion temperature, which was maintained below 10°C during batter preparation. The chicken breast was then added to the chicken emulsion and mixed for 5 min. Spherical chicken nugget samples, each weighing 50 g, were then prepared. The frying oil was maintained at ±2°C of the set temperature (180°C) using a programmable temperature controller (Eutech Instrument Pte Ltd., Singapore). Fresh soy oil was preheated at 180°C for 30 min prior to normal frying and it was then used to fry the chicken nuggets for 5 min. After frying, the samples were immediately removed from the oil and blotted gently with dry tissue papers to remove