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Improving the physico-chemical and sensory characteristics of camel meat burger patties using ginger extract and papain

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ABSTRACT

The objective of the current study was to include tenderizing agents in the formulation of camel meat burger patties to improve the physico-chemical and sensory characteristics of the product. Camel meat burger patties were processed with addition of ginger extract (7%), papain (0.01%) and mixture of ginger extract (5%) and papain (0.005%) in addition to control. Addition of ginger, papain and their mixture resulted in significant ($P < 0.05$) increase of the collagen solubility and sensory scores (juiciness, tenderness and overall acceptability) with significant ($P < 0.05$) reduction of the shear force values. Ginger extract resulted in extensive fragmentation of myofibrils; however, papain extract caused noticeable destructive effect on connective tissue. Moreover, ginger and papain resulted in improvement of the lipid stability of treated burger patties during storage. Therefore, addition of ginger extract and papain powder during formulation of camel burger patties can improve their physico-chemical and sensory properties.

1. Introduction

Consumer demand for fast foods has been increased rapidly in recent years due to drastic changes of life style. Meat burger patty is one of the most popular meat products that are under extensive consumption as fast meals especially in Arab countries. The most common meat raw material that is extensively used for production of burger patties is beef. The increasing price of the beef as raw meat materials required for manufacture of meat products has encouraged the food processors to evaluate the possibility of utilization of other low cost and high quality meat source such as camel meat especially in Asian and African countries where camel meat is available and considered more efficient than the other farm animals in the production of meat. The total number of camels in the world is about 25 million and the worldwide market for camel products has a prospective of ten billion dollars per year (Mirzaei, 2012). A camel carcass can provide a substantial amount of meat for human consumption. There is a high demand for camel meat to be used in meat products even in societies not rearing camel. The low fat content with relatively high polyunsaturated fatty acids, high moisture contents, high proportion of good quality proteins rich in essential amino acids, low level of cholesterol and high level of vitamins especially vitamin B complex makes camel meat a healthy food for humans (Kadim, Mahgoub, & Purchas, 2008). Moreover, the high water holding capacity of this meat is giving it a good processing properties (Babiker & Yousif, 1990) that can be recommended as an important raw material for production of many meat products (Farouk & Bekhit, 2013).

Although camel meat may be considered as a valuable raw material for formulation of meat products, a most important trouble associated with this meat is its higher connective tissue content which makes it a tougher kind of meat (Kadim et al., 2008). This is mainly because camel meat usually comes from old animals that have served other functions in their life or at the time that their labor performance and milk yield decline (Wilson, 1998). The high amount of connective tissue makes the camel meat a challenging raw material for production of acceptable meat product. Therefore, various methods have been established to tenderize camel meat to be suitable for further processing of different products.

The process of meat tenderization is recognized to be enzymatic in nature and involves endogenous proteolytic systems of meat itself which are responsible for tenderization during natural aging. However, when tenderization is desired to be enhanced, plant or microbial enzymes can be added (Lantto et al., 2010). Treatments by proteolytic enzymes are popular methods for meat tenderization and the most widely used exogenous enzymes in meat tenderization are the plant enzymes papain, bromelain and ficin as well as bacterial collagenase (Kang & Rice, 1970; Stanton & Light, 1987). Recently, proteolytic enzyme derived from ginger rhizome (*Zingiber officinale Roscoe*) and fruits of *Cucumis trigonus Roxb* plant has been reported to be effective for tenderization of tough meat from culled animals (Garg & Mendiratta, 2006; Naveena & Mendiratta, 2004; Naveena, Mendiratta, & Anjaneyulu,

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2004). Exogenous proteases are capable of digesting connective tissue and muscle proteins (Grzonka, Kasprzykowski, & Wiczk, 2007). Besides tenderizing properties, antioxidant characteristics of ginger extract have been reported by different workers (Lee, Kim, & Ashmore, 1986; Kim & Lee, 1995; Mendiratta, Anjaneyulu, Lakshmanan, Naveena, & Bisht, 2000).

Most of the previous studies conducted on the usage of plant derived proteolytic enzymes were directed to tenderization of fresh meat, however, the use of these enzymes for improving the characteristics of these meat when incorporated as raw material in meat products are limited. Therefore, the goal of the current study was to include tenderizing agents in the formulation of camel burger to improve the physico-chemical and sensory characteristics of the product. On the other hand, meat processors are concerned about the quality characteristics of processed products under storage. Therefore, prepared camel burger patties were stored at −18 °C for 3 months (shelf-life of burger) and the quality characteristics were assessed post-processing. This work may encourage meat processors to use camel meat for production of high quality meat products.

2. Materials and methods

2.1. Experimental design

A three replicate based experiment (three independent replicates at different times) was carried out to investigate the effect of incorporating ginger extract (7%), papain (0.01%) as well as mixture of ginger extract 5% and papain 0.005% during formulation of camel burger patties on the physico-chemical and sensory characteristics of prepared product. Moreover, the prepared burger patties at each replicate were stored at −18 °C for 3 months and examined monthly for sensory quality, pH, thiobarbituric acid and total volatile base nitrogen).

2.2. Enzymes preparation

Readily available papain enzyme powder from standard firm (Loba Chemie, Mumbai, India) was used. The recommended concentration was dissolved in distilled water just before application. Fresh ginger rhizome (*Z. officinale Roscoe*) was purchased from a local supermarket. The rhizome was peeled, sliced and blended with equal quantity of chilled distilled water for 1–2 min. The slurry was then filtered with four layers of muslin cloth and the filtrate was collected as the crude ginger extract. This crude extract was used as a source of proteolytic enzymes in subsequent application to meat.

2.3. Preparation of burger ingredients

Five fresh chucks and hump fat of ~8 years old female camels (*Camelus dromedarius*) were obtained from 5 animals, 1 h after slaughter from a slaughter house (Cairo, Egypt). The meat and fat were rapidly transported to the laboratory wrapped in polyethylene bags where they were stored at 4 °C overnight before use. Sodium tripolyphosphate and seasonings mix were obtained from Loba Chemie, Mumbai, India. Moreover, the sodium chloride and starch were obtained from a local market at Cairo, Egypt.

2.4. Products formulation

A base batter was prepared by using a simple traditional formulation as follows: 65% lean camel meat, 17% hump fat, 1.8% sodium chloride, 11% water, 5% starch, 0.3% sodium tripolyphosphate and 0.05% seasonings mix. Four formulas were prepared from the base batter by addition of ginger extract at rate of 7% to the 1st formula, papain at a rate of 0.01% to the 2nd formula; mixture of ginger extract (5%) and papain (0.005%) to the 3rd formula and the 4th formula was left as control without addition of any tenderizing ingredient. The levels of ginger and papain used in this study were based on a preliminary experiment to choose the concentration that gives a good tenderizing effect beside the previous studies. The percentage of the extracts was calculated as *v*/*w* of the whole formula.

2.5. Burger processing and storage

Three independent replicates for each burger formula were processed. For each replicate, the cooled camel meat and fat were ground through a 4.5-mm plate grinder (Seydelmann NW 114 E; Stuttgart, Deutschland, Germany). The ground meat and fat were mixed together with water, salt, starch, polyphosphates and seasonings. The mixture was divided into the following four treatment groups: the 1st group treated with ginger extract at rate of 7% (*v*/*w*), the 3rd group was treated with ginger extract 5% (*v*/*w*), while 2nd and 4th groups were left at this step without any treatment. After overnight storage at 4 °C, papain powder at rate of 0.01% (*w*/w) was added to the 2nd group, papain powder at rate of 0.005% (*w*/w) was added to the 3rd group (treated with ginger extract 5%), however, the 4th group was left without any treatment as control. Therefore, 4 formulas were prepared; the 1st one was treated with ginger extract 7% and stored overnight at 4 °C, the second one was treated with papain 0.01% added instantly, the 3rd one was treated with mixture of ginger extract 5% (stored overnight at 4 °C) plus papain 0.005% added instantly, however, the 4th formula was kept without any treatment (control). Afterward the mixture of each formula was mixed by hand for 5 min. A commercial burger maker with 9-cm internal diameter was then used to shape this mixture into burger patties of approximately 75 g and 1-cm thickness. Thirty burger patties were prepared from each formulation for each replicate. The patties were placed in plastic packaging films, held at −40 °C for 30 min and then placed in plastic containers and stored at −18 °C for 3 months. For each replicate, samples were withdrawn from each formula for analysis at 2nd day (0-time) and monthly.

2.6. Burger patties analysis

The proximate chemical analysis, collagen solubility, shear force, color values, cooking loss and moisture and fat retention values were determined at 0-time only. However, pH, thiobarbituric acid, total volatile base nitrogen values and sensory attributes were determined at 0-time and every month for 3 months. Burgers were thawed in a chiller at 4 °C before analysis.

2.6.1. Proximate composition analysis

Moisture, protein, fat and ash contents of burger patties from different formulas were determined for each replicate after the processing according to the method of AOAC (2000). For determination of moisture contents (g % sample), 3 g of sample were dried at 100 °C until constant weight was obtained. Protein content (g % sample) was determined according to the Kjeldahl method of analysis. For conversion of nitrogen into crude protein, a factor 6.25 was used. Fat (g % sample) was determined by 6-cycle extraction with petroleum ether in a soxhlet apparatus and calculating the weight loss. Ash was determined by ignition at 500 °C for 5 h (g % sample). Moreover, the proximate chemical analysis was conducted for cooked burger patties. The cooking was performed in a convection oven (Heraeus, D-63450 Hanau, Germany) adjusted at 180 °C to an internal temperature 75 °C and the cooking temperature was monitored by a needle thermocouple probe attached to a previously calibrated hand-held thermometer (Hanna HI 985091–1; Pasadena, TX, USA).

2.6.2. pH, thiobarbituric acid reactive substances (TBARS) and total volatile base nitrogen (TVBN) values

The pH, TBARS and TVBN values were determined after processing and monthly during storage. For measurement of pH value, five grams from each of the burger patties was homogenized with 20 ml distilled