Physico-chemical and sensory properties of polyphosphate-treated, irradiated, pre-cooked beef

by

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I declare that the dissertation, which I hereby submit for the MSc degree in Food Science at the University of Pretoria is my own work and has not been previously submitted by me for a degree at any other University or institution of higher education.

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ABSTRACT

PHYSICO-CHEMICAL AND SENSORY PROPERTIES OF POLYPHOSPHATE TREATED, IRRADIATED PRECOOKED BEEF

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Irradiation sterilization of precooked, hermetically sealed meat provides a shelf-stable, ready-to-eat product that can be stored for long periods of time without refrigeration. The Atomic Energy Corporation of South Africa started to develop precooked, shelf-stable meat products during the late 1970's, using gamma radiation from a ^{60}Co source at dose levels of at least 45 kGy. A number of meat dishes were successfully developed though problems were experienced with the texture of dry-packed roast beef slices, as these were found to be slightly dry.

Polyphosphates can possibly be used to alleviate the textural problems found in precooked irradiation-sterilized meat because polyphosphates are known to increase the water binding properties of meat proteins, resulting in a juicy, tender product. The choice of cattle breed used for the preparation of precooked meat dishes may also affect cooked meat texture, due to genotypic differences in the amount and especially the solubility of collagen.

Biceps femoris and *semitendinosus* muscles obtained from Afrikaner (*Bos Indicus*), Hereford (*Bos Taurus*) and Simmental (*Bos Taurus*) steers were treated with low levels of sodium tripolyphosphate (0.3 % and 0.5 %) and tetrasodium pyrophosphate (0.22 % and 0.36 %) in combination with 0.7 % salt. The precooked meat was vacuum packed in flexible pouches and irradiated in the frozen state (-40 °C) with a

^{60}Co gamma source until a minimum target dose of 45 kGy was reached. Various physico-chemical tests as well as descriptive generic sensory evaluation were performed on the samples to determine the effect of breed, polyphosphate treatment and irradiation on the physico-chemical and sensory properties of irradiated precooked beef.

Cattle breed affected the texture of precooked, irradiated, shelf-stable beef, with Afrikaner *biceps femoris* giving a more tender, juicy product than that of Hereford and Simmental. The low levels of polyphosphates used in combination with salt successfully increased the juiciness and tenderness of precooked, shelf-stable beef. There was little difference in the physico-chemical and sensory results obtained from samples treated with the two different polyphosphates, or the level at which the polyphosphates were administered.

Irradiation sterilisation of precooked beef resulted in a tender product. Comparison of irradiated and non-irradiated samples revealed that the irradiated samples had longer sarcomere and I-band lengths, and shorter A-band lengths, which explained the increased tenderness in irradiated samples. An increase in both soluble collagen and % collagen solubility after irradiation sterilization further substantiated the tenderness results. Treatment of the *biceps femoris* with low levels of sodium tripolyphosphate or tetrasodium pyrophosphate in combination with salt, prior to cooking and irradiation, resulted in a juicy, shelf-stable product.

Irradiation sterilisation did, however, produce a detectable wet dog flavour and aroma, and more research is required into improving the flavour and aroma of irradiation sterilized beef.

Although this research indicated that irradiation of cooked, polyphosphate treated Afrikaner meat resulted in the most tender and juicy end-products, it is recommended that sensory evaluation using a consumer panel also be conducted, in order to determine if this level of tenderness is acceptable, or if it is over tender due to excessive degradation of the connective tissue.

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