EFFECT OF FROZEN STORAGE TIME ON QUALITY CHICKEN NUGGETS

R. Teruel, M. Espinosa, M. Egea, M.B. Linares, M.D. Garrido*
Department of Food Technology, Nutrition and Bromatology, Veterinary Faculty, University of Murcia, Espinardo, 30071 Murcia, Spain
*mgarrido@um.es

Abstract – Physico-chemical (lipid oxidation, colour and pH analyses) and sensory characteristics (odour intensity, rancid odour, colour crust, colour mass, taste intensity, rancid taste, crispness, juiciness, firmness, cohesiveness) of chicken nuggets were determined at different frozen storage times (-18ºC) along 270 days. The frozen storage did not affect to colour parameters (a* and b*) and pH over 270 days. Regarding lipid oxidation, the nuggets were stable until 180 days but later a significant increase was produced (P<0.05), indicating the beginning of deterioration. Trained panel evaluated the sensory characteristics of cooked nuggets using a quantitative descriptive analysis (QDA) concluding that in general, sensory attributes were not affected by storage time. The odour and taste intensity were highly valued by judges while for rancid attribute no significant differences were described (P>0.05). In conclusion, chicken nuggets can be stored under frozen conditions without any preservative until 180 days where the oxidation process started to affect the products quality evaluation.

I. INTRODUCTION

The chicken-based foodstuffs are becoming increasingly popular with a growing consumption mainly as "ready-to-eat" products, such as frozen chicken nuggets since less spending time on preparation, good nutritional quality as a protein source and low cost are provided (1). A desirable high-polyunsaturated acid profile in chicken meat is described, that although may be nutritionally interesting makes the product very susceptible to oxidative reactions (2) which can be intensified by the culinary technique, a deep-frying process, that is required to get ready this product. These changes could affect the physic-chemicals parameters and sensory attributes (odour, colour, and flavour) on frozen nuggets (3). In many products, changes in sensory characteristics occur largely before any risk to consumers' health can be reached, therefore shelf-life of majority of food products is determined by sensorial deterioration (4). In this context, the aim of this work was to evaluate the effect of frozen storage in physico-chemical and sensory quality in chicken nuggets.

II. MATERIALS AND METHODS

The nuggets were experimentally manufactured according to the market pre fried products formulation. For this purpose deboned skinless chicken breasts (60%) were minced with ice (23%) in a chopper equipped for 30 seconds. They were mixed with the typical additives for commercial nuggets (15% potato flakes, 1% salt and 1% albumin). All components were thoroughly mixed to provide an uniform blend, and the chicken nugget samples were prepared in characteristic shapes of 5×3×1 cm, each weighing 25 g and were freezing until −18 °C. The pieces were dipped in the prepared batter for 15 seconds (wheat flour 93.57 %, salt 1.17% bicarbonate 0.24%, yeast 2.34% and xanthan gum 1.17%). A total of 128 chicken nuggets were used (16 nuggets per batch x 4 times x 2 replicates each). Chicken nuggets were pre fried using a traditional fryer (Taurus, Spain) for 30 seconds at 165ºC in sunflower oil (Hacendado, Sovena Spain S.A.) and packaged in polyethylene bags and stored at frozen temperature (−18 °C) for 270 days.
Physico-chemical [pH, Crison GLP21 equipment (5); colour coordinates, Minolta CR400 (Osaka, Japan); Thiobarbituric acid reactive substances, TBARS, Tarladgis et al. (7)] and sensory analysis [Qualitative Descriptive Analysis (QDA) (6) using an unstructured scale of 10 cm by a trained panel consisting of 9 judges] were carried out in the samples at 0, 90, 180 and 270 days.

Data were analysed using the statistical package SPSS 19.0 (Statistical Package for the Social Science for Window).

III. RESULTS

The Table 1 shows the meat quality on chicken nuggets along the frozen storage. The initial pH values were similar to previous researches in similar products (8). No significant differences were described in the pH values due to frozen storage and treatments, in agreement Modi *et al.* (9) who did not find significant differences on pH values during 6 months frozen storage in curry chicken.

Table 1 Physico–chemical parameters of chicken nuggets during the frozen storage for 270 days

	Storage time (days)			
	0	90	180	270
L*	63.1±3.7^{a}	71.0±2.1^{b}	72.4±1.3^{b}	68.6±1.8^{b}
a*	-0.5±0.3	-0.7±0.4	-1.1±0.4	-0.9±0.2
b*	15.0±2.0	14.1±2.0	13.7±2.3	12.3±3.0
pH	6.3±0.0	6.4±0.1	6.3±0.2	6.3±0.1
TBARS	4.5±0.4^{a}	4.8±0.6^{a}	4.6±0.6^{a}	5.8±0.6^{b}

All date are expressed as mean value standard desviation. Different letters (a-b) indicate significant differences among storage times according a Tukey test (P<0.05).

As respect the colour coordinates, no significant effect (P>0.05) of storage time was showed on a* and b* colour parameters. L* coordinate was stable between 90 and 270 days, however, a decreased of luminosity (P<0.05) was showed in comparison with initial values. In general, freezing treatment tends to reduce L* probably due to a decrease in the water-holding capacity usual in this frozen process (10). TBARS values (mg malondialdehyde / kg sample) were stable until 180 days due to the low temperatures. Following, a significant lipid oxidation value (P<0.05) at 270 days indicated the beginning of product deterioration. In the same way, Modi et al. (11) reported marked increase in TBARS values after 180 days of frozen storage of chicken nuggets.

Table 2 Sensory quality of chicken nuggets during the frozen storage for 270 days

	Storage time (days)			
	0	90	180	270
OI	10.0±0.1	9.6±0.7	9.4±0.6	9.5±0.5
RO	0.0±0.0	0.00±0.0	0.0±0.0	0.0±0.0
CC	10.0±0.0	9.7±0.5	9.6±0.6	9.7±0.4
MC	9.9±0.3	9.8±0.4	9.6±0.6	9.7±0.4
TI	9.9±0.2	9.6±0.8	9.6±0.5	9.2±0.6
RT	0.0±0.0	0.0±0.0	0.0±0.0	0.1±0.2
C	5.9±1.3^{ab}	6.2±1.8^{a}	5.2±0.8^{ab}	4.2±1.3^{b}
J	6.6±0.9^{a}	5.6±1.3^{ab}	4.8±1.0^{b}	4.9±0.9^{b}
F	4.3±1.1^{ab}	4.9±1.1^{a}	3.2±1.3^{b}	3.8±0.8^{ab}
CO	4.6±1.0^{b}	5.6±1.2^{b}	2.8±1.3^{a}	4.5±1.1^{b}

OI: Odour intensity; RO: Rancid odour; CC: Crust colour; MC: Mass colour; TI: Taste intensity; RT: Rancid Taste; C: Crispness; J: Juiciness; F: Firmness; CO: Cohesiveness. All date are expressed as mean value standard desviation. Different letters (a-b) indicate significant differences among storage times according a Tukey test (P<0.05).

The results of the sensory evaluation are presented in Table 2. In general sensory attributes (odour intensity, rancid odour, crust colour, mass colour, taste intensity, and rancid taste) were not affected by storage time (P>0.05). Significant differences were observed in texture attributes (crispness, juiciness, firmness, and cohesiveness) but did not follow a consistent trend, probably related with the small differences produce from the handmade productions process. The juiciness value shows a clear decrease along storage time likely associated with water losses by freezing. The odour and taste intensity were highly valued by panellists and were always scored on the top scale along 270 days of storage time. In regard to rancid odour and rancid taste no significant difference were showed (P>0.05). Colour attributes, crust colour and mass colour, did not vary by effect of the frozen treatment in agreement with instrumental analyses, and similar result were found by Seleni et al. (3) in cooked chicken meat with respect frozen storage (270 days).

IV. CONCLUSION

This study evaluated the impact of frozen storage at −18 °C for a period of 270 days on physico- chemical and sensory characteristics of chicken nuggets. It can be concluded that frozen storage has a protective effect against oxidative reactions until 180 storage days. Colour, pH and sensory characteristics remained practically stable along storage at 270 days. Therefore, chicken nuggets without any preservatives can be stored at -18ºC without quality losses for 270 days but the oxidative reactions began to be detectable at 180 days.

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