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Technological characteristics of rabbit meat with raised n-3 PUFA

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RIASSUNTO – Proprietà tecnologiche della carne di coniglio arricchita in PUFA n-3 – *La ricerca ha avuto lo scopo di valutare alcune caratteristiche tecnologiche di prodotti trasformati (impasti di carne macinata e hamburger) provenienti da conigli alimentati con diete prive o contenenti l'8% di semi di lino. L'inclusione di semi di lino nella dieta ha determinato un significativo aumento della suscettibilità ossidativa (TBARS) degli impasti sia a 3 che a 6 mesi di conservazione a -20°C, mentre l'analisi sensoriale ha fatto rilevare la comparsa di sapore di rancido solo dopo 3 mesi di conservazione. Le variazioni di colore degli hamburger durante la conservazione a 2-4°C in atmosfera ordinaria o sottovuoto sono risultate comparabili nei due gruppi sperimentali.*

KEY WORDS: rabbit, n-3 PUFA, processed meat, colour, storage.

INTRODUCTION – The dietary use of linseed in animal feeding has been proposed by many authors as a vegetable way (in alternative to fish oil or fish meal) to raise meat PUFA and mainly α-linolenic acid (C18:3 n-3) (Bernardini *et al.*, 1999; Mattews *et al.*, 2000; Riley *et al.*, 2000; Rey *et al.*, 2001). However, increasing amounts of PUFA could impair the technological characteristics of the meat for further processing (Enser, 1999). Main problems are concerned with lipid stability and meat colour changes over time which are related with both the out coming of rancid flavour and detrimental effects on the appearance of packaged further processed meat products. A study was conducted to investigate the susceptibility to lipid oxidation and colour changes during storage of further processed rabbit meat products (hamburgers and meat batters for hamburger production) with raised n-3 PUFA.

MATERIAL AND METHODS – Diets containing 0 or 8% of whole linseed were fed to two groups of rabbits (LIN0 or LIN8) during the second phase of fattening from 65 up to 87 d of age. After slaughtering, 35 carcasses from each experimental group were deboned and the dissected meat was separately minced and mixed with spices and additives specifically developed to prepare two different meat batters (LIN0 or LIN8) for industrial hamburger production. A total of 96 hamburgers (48 LIN0 and 48 LIN8) were prepared with the meat batters. Six-teen hamburgers from each group were analysed for cooking loss (by cooking the samples on convention oven at 180°C until 72°C at core sample), moisture, protein (AOAC, 1990) and lipid content (Folch method). The lipid fatty acid composition were determined by gas chromatography and fatty acid methyl esters were expressed as wt% of total fatty acid methyl esters. Moreover, 32 hamburgers from each group were packaged on both ordinary atmosphere (OA) and vacuum (VA). Colour changes (CIE Lab, 1976) over 14 d storage at 2-4°C were determined on each hamburger by calculating the colour difference over time as follows: $\Delta E^* = [(L_1^* - L_2^*)^2 + (a_1^* - a_2^*)^2 + (b_1^* - b_2^*)^2]^{1/2}$, where L_1^*, a_1^*, b_1^*, represent the initial colour readings measured at time "0", and L_2^*, a_2^*, b_2^* refer to each subsequent measuring time (days 3, 5, 7, 10, 12, 14). Furthermore, 20 kg of meat batter from each experimental group were vacuum packaged, and stored at -20° C for 3 or 6 months before measuring the lipid susceptibility to oxidation (TBARS induced test, Kornbrust and Mavis, 1980; Lowry *et al.*, 1951) and carring out triangular sensory test (18 untrained judges) to detect differences in meat flavour after 3 or 6 months frozen storage. Data were analysed by using one-way ANOVA (SAS, 1988).

RESULTS AND CONCLUSIONS – Meat batter from LIN8 group exhibited a higher susceptibility to lipid oxidation (TBARS) at both 3 and 6 months of frozen storage (P<0.01) (Fig. 1). Triangular sensory test showed a marked rancid flavour in LIN8 meat batter but only at 6 months of storage (P<0.05). This storage time is considered the shelf-life limit for industrial storage of comminuted meat. These findings suggest the possibility of using frozen rabbit meat batter with raised PUFA for the industrial hamburger production within the sixth month of frozen storage. The higher susceptibility to lipid oxidation and the development of rancidity in LIN8 meat batter are due to the increasing amounts of both total PUFA (35.3% in LIN8 *vs* 27.1% in LIN0, P<0.01) and α-linolenic acid (C18:3 n-3) (11.3 *vs* 3.6%, P<0.01). The effectiveness of whole linseed to increase the PUFA and α-linolenic acid contents in meat has been previously reported by several studies on rabbit (Bernardini *et al.*, 1999) and other species (Mattews *et al.*, 2000; Riley *et al.*, 2000; Rey *et al.*, 2001). Colour changes of hamburgers during storage on both ordinary atmosphere (OA) and vacuum (VA) are shown in Figure 2. When considering the effect of dietary inclusion of whole linseed, no differences were found between the experimental groups neither in OA or VA packaging, while colour differences (ΔE*) were significantly affected by the type of packaging resulting in higher colour variation of vacuum packaging. This could be due to the well known effect of vacuum to prevent the oxygenation of the red purple myoglobin to produce the bright coloured oxymioglobin. No differences were found on cooking loss and chemical composition of hamburgers between experimental groups. These results clearly indicate that enhancing the n-3 PUFA content of rabbit meat by dietary inclusion of whole linseed had detrimental effect on lipid stability of meat batters for hamburger production. However, the higher susceptibility to lipid oxidation developed rancid flavour only at six months of frozen storage. Colour changes of chilled hamburgers were not affected by dietary treatment whereas the vacuum packaging determined higher colour variation in respect with the ordinary atmosphere.

Figure 1. Susceptibility to lipid oxidation (TBARS) and triangular sensory test of rabbit meat batter (A,B = P<0.01).

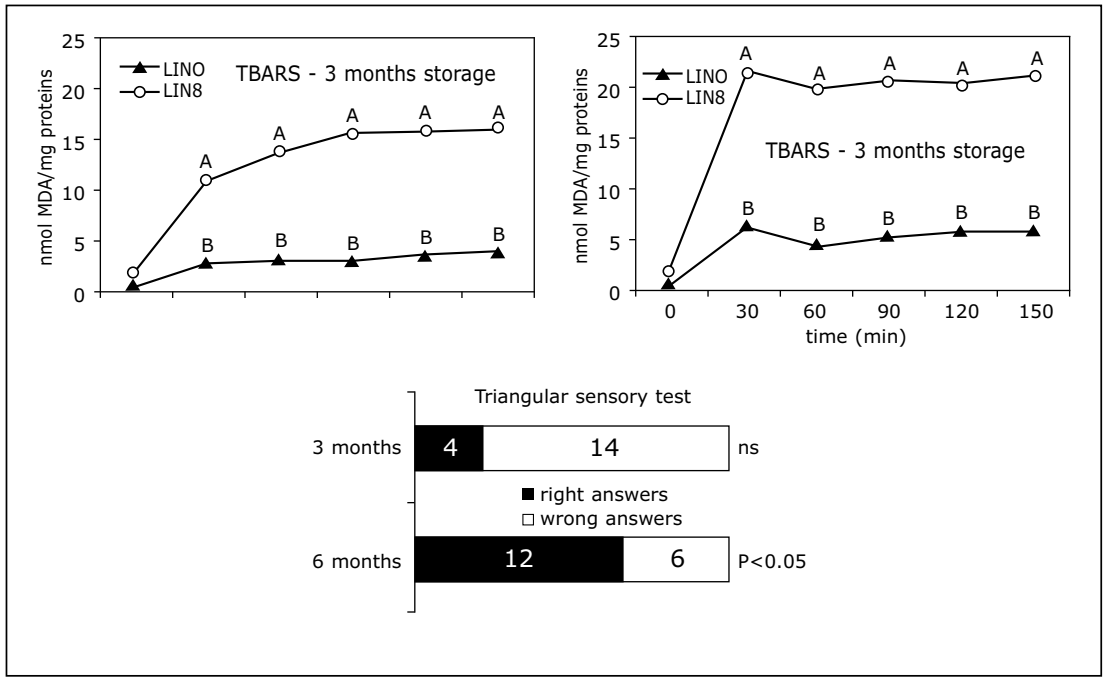
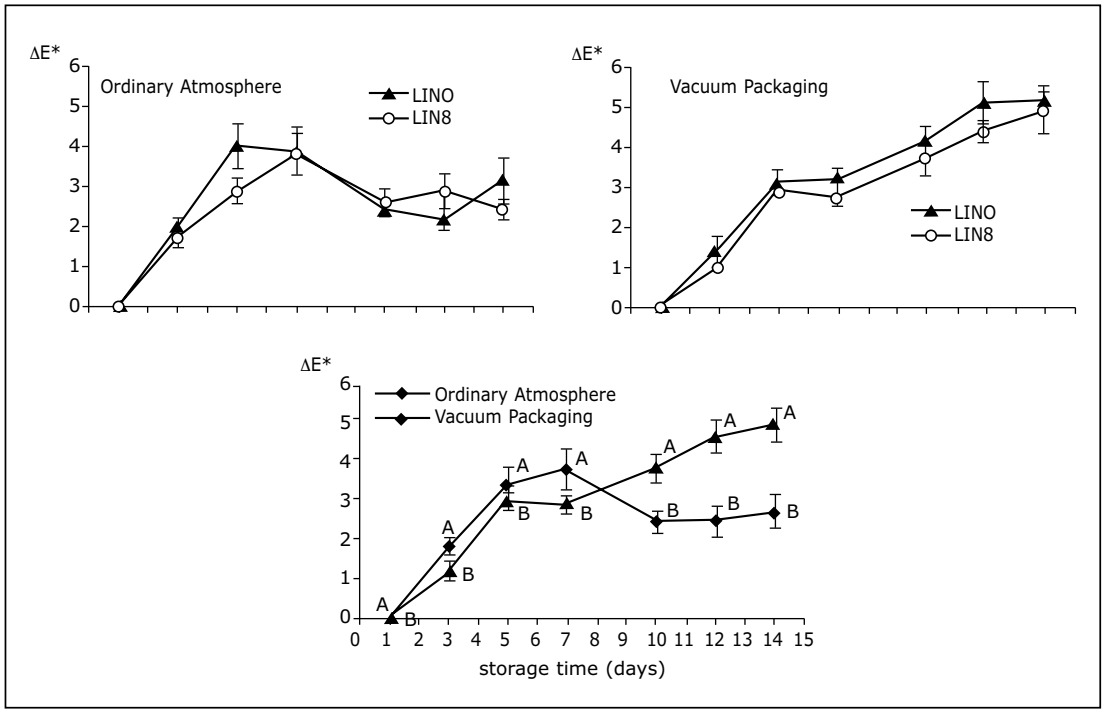


Figure 2. Colour difference (ΔE*) on chilled hamburgers (A,B = P<0.01).



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