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Preliminary approach on early *post mortem* stress and quality indexes changes in large size bluefin tuna (*Thunnus thynnus*)

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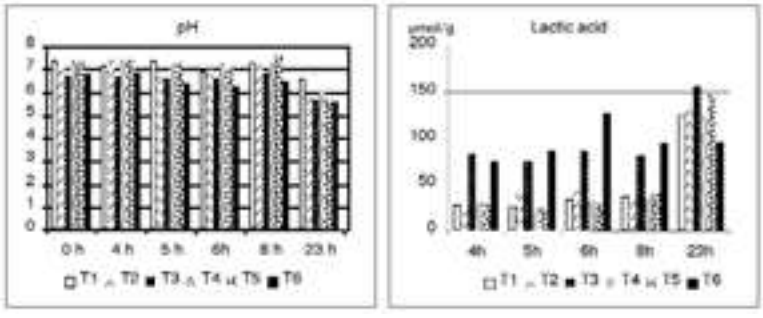
RIASSUNTO – Approccio preliminare ai primi cambiamenti post mortem degli indici di stress e qualità in tonno rosso (*Thunnus thynnus*) di grossa taglia. *Lo studio preliminare dei parametri indici di stress e di qualità nel tonno rosso è stato effettuato a 0, 4, 6, 8, 23 ore dalla morte su soggetti (lunghezza alla forca*

*234,7±16,9 cm, lunghezza testa 62,8±5,6 cm, peso medio del tronco 167,2±45,1 kg e peso vivo stimato 225±60 kg) allevati in gabbie a mare e uccisi in sequenza direttamente in acqua mediante colpo di fucile. I valori di cortisolo e acido lattico ematici e di pH, ATP, acido lattico, colore muscolari hanno indicato animali non stressati (T1-primo catturato e T4) e stressati (T3-particolari problemi alla cattura e T6-ultimo catturato). Significative sono state le correlazioni fra acido lattico e pH (-0,93**) e tinta (-0,82*) muscolari. Nel complesso i parametri a livello tissutale come pH, ATP, ADP e AEC sono risultati correlati in senso negativo con acido lattico, IMP, ipoxantina, luminosità e tinta.*

Key words: bluefin tuna, stress, quality, post mortem changes.

INTRODUCTION – Bluefin tuna (*Thunnus thynnus*) is very appreciated on Japan and USA market for the preparation of sushi and sahimi. The market price of the fresh product can vary from 8 to 33 Euro/kg (gate farm/producers prices) according to size, shape, fat level, meat colour, consistency and freshness (absence of "hyake"), all parameters strictly connected to feeding quality and quantity, rearing and killing stress factors and refrigeration times and conditions after death. Excessive levels of stress during the slaughtering can affect meat quality, contributing to significantly decrease of tuna's price. The present trial was carried out to evaluate the possible harvesting/slaughtering stress effect on reared bluefin tuna meat quality, starting from the examination of the most important stress and quality parameters changes during the early *post mortem* period.

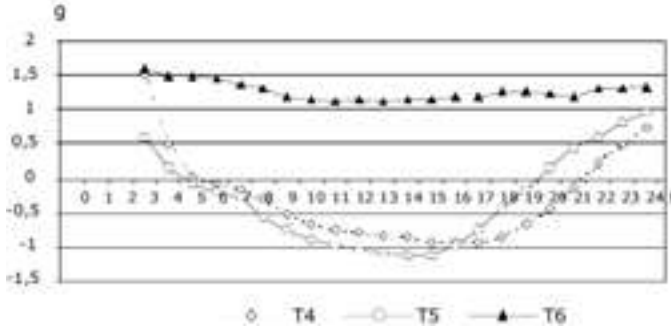
MATERIALS AND METHODS – Bluefin tuna (*Thunnus thynnus*) transferred and stocked in cage (50 m diameter, 20 m depth) of Vibo Marina (VV) tuna farm were fed from June to December mixed diet (anchovies, mackerels, sardines, herrings), 1-5% b.w. according to water temperature (12-28°C). Six tunas were killed in the same day, one by one in sequence from subject 1 (T1) to subject 6 (T6), with a diver gun with hunting cartridge. Time from start to end of catching was 2.5 h. Subject 3 had more problems during catching. At death blood was collected and analysed for haematocrit, cortisol (RIA Technogenetics, Milano, Italy), glucose (com-



mercial kit - SIGMA, Milano, Italy) and lactic acid (Roche Diagnostics, Italy). Immediately after head cutting, gutting and tail cutting on board, the tail including the fifth finlet was quickly landed, transferred in the laboratory and stored in cold store with ice covering. At 4, 5, 6, 8 and 23 hours after death samples of muscle were extracted for the determination of lactic acid (R-Biopharm enzymatic Bioanalysis) and ATP and related catabolites - ADP, AMP, IMP, inosine and hypoxanthine - with HPLC (Burns and Ke, 1985). AEC (Adenilate Energy Charge) was calculated (ATP+0.5ADP/ATP+ADP+AMP). Muscular pH, temperature and fillet colour (by Minolta colorimeter, CIE L*a*b* method) were measured at 0, 4, 5, 6, 8 and 23 hours after death. Samples of muscle in duplicate of the 3 last killed tunas were taken to determine the isometric contraction force, measured *in continuum* from 3 to 24 hours after death.

RESULTS AND CONCLUSIONS – Sampled tunas had 234.7±16.9 cm standard length, 62.8±5.6 cm head

length, 167.2±45.1 kg trunk weight and 225.7±60 kg estimated total body weight.
Haematic parameters. Haematocrit (28.0±4.0%) showed a minimum of 22% in T4 and a maximum of 34% in T6, glycemia (122.5±26.7 mg/dl) ranged from 100 mg/dl in T2 to 172 mg/dl in T5, lactic acid (9.4±9.2 mg/dl) showed 3.1 and 0.7 mg/dl in T1 and T4 *vs.* 24.1 and 17.0 mg/dl in T3 and T6, cortisol (152.5±165.6 nmol/l) varied more



markedly, with values from 1, 4, 20 nmol/l in T2, T4 and T1 to 227, 282 and 381 nmol/l in T3, T6 and T5.
Muscular stress/quality indexes. Tuna's tail temperature decreased (R^2=0.264**) from 24.8±0.7°C at death to 8.1±1.4°C after 23 h ice covering and most of the studied stress/quality indexes showed significant changes with time of storage.

As showed in figure 1, pH values decreased (R^2=0.538***) from 6.84±0.38 at death to 5.88±0.37 at 23 hours after death. T1, T2 and T4 maintained pH higher than 7 at death and at 4 and 8 hours after death, while T3 and T6 had pH values always under 6.85. At 23 hours after death, pH decreased in all tuna, T1, T2 and T4 showing still higher values than T3, T5 and T6.

On average lactic acid increased (R^2=0.584***) with the time of storage, ranging from 44.7±26.6 to 59.3±39.4 μmol/g in the first 8 hours of storage. T3 and T6 showed the highest levels of lactic acid during the first 8