Fisheries Research 164 (2015) 59–63

Contents lists available at ScienceDirect

Fisheries Research

journal homepage: www.elsevier.com/locate/fishres

At-sea factors that affect yellowfin tuna grade in the Gulf of Mexico pelagic longline tuna fishery

Daniel G. Foster[a,*], Glenn R. Parsons[b], Derke Snodgrass[c], Arvind Shah[d]

[a] Harvesting Systems Unit, NOAA Fisheries Service, Mississippi Laboratories, 3209 Frederic St., Pascagoula, MS 39567, USA
[b] Department of Biology, The University of Mississippi University, Oxford, MS 38677, USA
[c] NOAA Fisheries Service, 75 Virginia Beach Drive, Miami, FL 33149, USA
[d] Merck Research Laboratories, RY34-A312, PO Box. 2000, Rahway, NJ 07065, USA

ARTICLE INFO

Article history:
Received 19 November 2013
Received in revised form 14 October 2014
Accepted 16 October 2014
Handling Editor B. Morales-Nin

Keywords:
Yellowfin tuna
Burnt tuna syndrome
Tuna quality
Hook timers

ABSTRACT

Burnt tuna syndrome (BTS) is a term used to describe changes in raw tuna (sashimi) that is characterized by pale color, poor texture, and an "off" flavor. This reduction in tuna quality results in a much lower price for the fisher and significantly affects the profitability of tuna fisheries. In this study, we examine how at-sea factors, including the capture process, affect the quality of yellowfin tuna, *Thunnus albacares* caught in the northern Gulf of Mexico pelagic longline fishery. Hook timers were used to record the elapsed time between a tuna taking the hook and its eventual landing. The elapsed time on the hook, tuna length, and fish boarded alive were found to be positively correlated with the proportion of tuna grading #1, while fish boarded dead and days on ice were found to be negatively correlated.

Published by Elsevier B.V.

1. Introduction

The overall physiological changes that take place during and after organisms engage in exhaustive exercise are generally well known, while the changes that occur at the tissue and molecular level have received less attention. From an applied viewpoint, various cellular and sub-cellular changes have been correlated with the quality of the flesh in animals used for human consumption. For example, lowered muscle quality was correlated with ultrastructural changes at the sub-cellular level in pigs suffering from a condition known as "porcine stress syndrome" prior to slaughter (Boles et al., 1992; Block, 1994). In similar fashion, heat stress in domestic turkeys has been correlated with lowered meat quality, a situation referred to as pale, soft, exudative (PSE) meat. Strasburg and Chiang (2009) noted that the biochemical changes observed in the flesh of turkeys with PSE is similar to those observed in pigs suffering from porcine stress syndrome. This observation suggests that stress may result in consistent tissue changes across a variety of taxa.

Burnt tuna syndrome (BTS) is a term used to describe changes in raw tuna (sashimi) that is characterized by pale color, poor texture, and an "off" flavor. This reduction in tuna quality results in a much lower price for the fisher and significantly affects the profitability of tuna fisheries. Cramer et al. (1981) estimated that BTS results in a 16% annual loss in the value of the catch in the Hawaiian handline fishery. Burnt tuna and its prevention were first examined by Itokawa (1969). Cramer et al. (1981) examined stress induced changes in tuna flesh and found a significant correlation between postmortem handling of captured tuna and sashimi quality. However, in the same report the authors suggest that the physiological changes that occur during capture and the ensuing struggle may be more important in determining tuna quality. Davie and Sparksman (1986) compared ultrastructural changes in postmortem tunas and found that fewer sub-cellular changes were evident and ultrastructural quality of the flesh was better in tuna captured on longline as opposed to those captured on handline or rod and reel. The observed differences were attributed to the difference in capture times (time on the hook) between the fishing methods (Davie and Sparksman, 1986). Likewise, Block (1994) reported that burnt tuna is associated with fish that experience the greatest stress during short-term capture. It is clear there is still much to be learned regarding the factors that contribute to BTS and how this phenomenon is related to exhaustive exercise in tuna.

The U.S. Gulf of Mexico pelagic longline fishery primarily targets large (>25 kg dressed weight), high quality yellowfin tuna, *Thunnus albacares* intended for the sashimi market. The fishery accounted for between 12% and 41% of the total U.S. Atlantic yellowfin tuna landings from 2007 to 2011 (NMFS, 2012). While the majority of

* Corresponding author. Tel.: +1 2286234915.
E-mail address: Daniel.G.Foster@noaa.gov (D.G. Foster).

http://dx.doi.org/10.1016/j.fishres.2014.10.013
0165-7836/Published by Elsevier B.V.

the revenue generated by the fishery is from the sale of sashimi grade tuna, efforts to improve the understanding of factors that affect tuna quality have the potential to substantially increase the profitability of the fishery.

In this paper, we report on the results of a study to examine how at-sea factors, including the capture process, affect the quality of yellowfin tuna caught in the northern Gulf of Mexico pelagic longline fishery. Using hook timers we were able to measure the time elapsed between a tuna taking the hook and its eventual landing, and this information was correlated with the quality grade of the tuna.

2. Materials and methods

2.1. Experimental design

Two commercial pelagic longline vessels fished the northeastern Gulf of Mexico from February to June of 2012 during the study. Captains were allowed to fish normally and chose the location of fishing, length of trips, total number of hooks fished, etc. Three or five 16/0 circle hooks, baited with Spanish sardine, *Sardinells aurita* were deployed between each float. As required by federal regulation, gangion lengths were at least 10% greater than float line lengths for sea turtle conservation purposes. Hook depths (i.e. gangion + float line) ranged from 82 to 97 m. Mainline length per set varied from 28 to 59 km.

Hook timers (HTR's) (Lindgren Pitman HT 600) were deployed between the mainline and gangion on 300 consecutive hooks during each set. HTR's are stopwatches that record the elapsed time (hours and minutes) from the time the interaction starts until the fish is boarded. Temperature depth recorders (TDR's) (Lotek LAT1100), attached nine meters above the hook, were placed on as many as 150 of the hooks containing HTR's. TDR's record temperature and depth at 1–2 min intervals (depending upon the duration of the trip), allowing the vertical fish activity to be monitored and the time of mortality to be estimated, should it occur. With its small design and minimal weight in water (~1.7 g), it is assumed that the TDR's have no effect on the performance of the fishing gear (P. Rice pers. comm.). Data were downloaded from the TDR's at the conclusion of each trip.

2.2. Data collection

All vessels participating in the experiment carried NOAA trained observers. Observers collected fishery data as described by the SEFSC pelagic longline observer program (POP) (Beerkircher et al., 2002). The time and location of each section of gear was recorded as it was deployed and retrieved. These data were obtained from the vessel's existing electronic equipment. The section number, time of fish landed on deck, and species were recorded for each animal captured. The straight line fork length of yellowfin tuna was recorded to the nearest centimeter. A carcass tag applied to each fish kept was used to match the data collected on that animal at-sea with the grade and dressed weight of the fish recorded during the unloading process at the dock. Dressed weight was taken with the head and fins removed and the fish eviscerated.

2.3. Tuna processing and grading

When tuna were brought aboard, great care was taken to gaff the fish in the head region. A carpet or mat was used minimize damage while struggling on deck. The butcher or his designated crewman made a determination as to which flank of the fish was more favorable and placed the blemished or least favorable side down against the deck. Later in the process, the pectoral fin was cut off to mark the highest quality side "top side" of the tuna. Tuna were stored in this orientation for the remainder of the trip.

Oftentimes, a club was used to stun the tuna with a sharp blow to the top of the head, between the eyes, allowing for less damage to be incurred during the rest of the handling process. Fish were bled by making a 2–4 cm incision into the bloodline of each side of the fish, posterior to each pectoral fin base. An additional incision was made across the ventral side of the fish just forward of the caudal peduncle to increase blood loss. The butcher then used a knife to cut a section of the forehead away to expose the anterior region of the braincase. A one meter long stainless steel Taniguchi wire was then inserted into the brain and neural canal to destroy the spinal cord, further subduing the fish to prevent additional damage during deck handling.

When multiple tuna were on deck, live tuna took priority in the order in which fish were processed. A heavy, meat saw was used to cut away the second dorsal fin, second anal fin, the pectoral fin of the high side of the fish (as previously mentioned) and the upper and lower lobes of the caudal fin, leaving the fork and caudal keels intact. Fish were gutted by making a cut, 4–5 cm long, just forward of the cloaca. The butcher inserted one or two fingers into the opening in order to pull out and cut the distal ends of the intestines and gonads close to the vent. The gills and head were detached and the visceral mass was pulled gently from the body with the head. Seawater and a wire brush were used to clean the vertebral area to remove all coagulated blood and kidneys. Tuna were then packed in ice with ice filling the visceral cavity. Fish were checked every day for the duration of the trip and repacked as necessary to ensure that the fish were completely surrounded by ice. Upon arrival at the dock and off-loading, the fish were rinsed with salt-water to free them and allow removal from the ice. As each tuna was off-loaded, it was weighed and graded.

A single buyer, with 28 years of experience buying tuna caught in the GOM, graded all of the tuna included in the analysis. The buyer was unaware of the objectives of the study. As is customary in the Gulf of Mexico yellowfin tuna fishery, fish that weighed less than 27.3 kg (60 lb) dressed weight were not graded, but classified as "no grade". Tail and core samples of muscle were used to evaluate the color, clarity, texture and fat content of each fish graded. Tuna grades ranged from 1 to 3 with grade #1 tuna being the highest or "sashimi grade" tuna.

2.4. Statistical methods

The vast majority (98%) of tuna used in the analysis graded either #1 or #2. Therefore, the data were transformed to a binary response variable indicating whether or not yellowfin graded #1. The relationship between the proportion of tuna grading #1 and the explanatory variables of *vessel, month group, fishing temperature, days on ice, fish length, sex, alive or dead at boarding*, and *elapsed time* was investigated using logistic regression analysis with maximum likelihood estimation procedure for binary response (Agresti, 2007; Draper and Smith, 1998; Hosmer and Lemeshow, 2004). Dichotomous variables were coded either −1 or 1. Month data were grouped as a binary response (February–April and May) to delineate between the pre-spawn and spawning season (Arocha et al., 2001). *Fishing temperature* was the mean fishing temperature of individual sets, as recorded from 20 randomly selected TDR's. *Days on ice*, was the number of calendar days from the time the fish was caught until the catch was brought in to port. *Elapsed time* was the time in minutes from the hook-up until the fish was brought aboard the vessel. Tuna with missing data were not included in the analysis. All statistical analyses were performed in SAS Statistical Software (SAS, version 9.1, SAS Inst., Inc., Cary, NC). Statistical significance was declared at $p \leq 0.05$.

Download English Version:

https://daneshyari.com/en/article/6385663

Download Persian Version:

https://daneshyari.com/article/6385663

Daneshyari.com