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QUALITY ENHANCEMENT AND SHELF-LIFE EXTENSION OF RED SHRIMP (ARISTEUS ANTENNATUS) DURING ICED STORAGE

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ABSTRACT

Shrimp blackspot is a serious problem in shrimp processing. Melanosis occurs on most shrimp species and decreases the commercial value and consumer acceptance of the shrimp product. Therefore, our objective was to evaluate the effect of sodium metabisulphite dipping treatment (0-1.25% for one minute) on melanosis inhibition, shelf – life and quality attributes of red marine shrimp, harvested along the Alexandria, coast Egypt. After dipping, draining and packaging, shrimp samples were stored in ice for 8 days at 4-5 °C.

The results indicated that blackspot developed rapidly in control shrimp approaching unacceptable after 4 days storage in ice. The short shelf- life of control samples reflects high values of biochemical indices, microbial load and off-odor scores. On the other hand, utilizing the current recommended dip procedure of 1.25% $Na_2 S_2 O_5$ for one minute, effectively retarded melanosis development, reduced the formation of nitrogenous compounds (TMA-N, TVB-N), slowed down the increase in TBC,pH,TBARS and off – odor scores associated with spoilage, and prolonged the shelf – life to seven days in iced – storage. A one minute exposure in 1.25% sulfite solution is sufficient to delay blackening defects and maintain a high quality shrimp product.

Keywords : Shrimp blackspot, Melanosis, Shelf – life – Sensory quality.

INTRODUCTION

Shrimp are one of the most popular sea foods consumed in Egypt, they are valuable sources of high quality proteins, vitamins and minerals (King *et al.*, 1990). In addition shrimp contain very low lipid levels (Bragagnolo and Rodriguez-Amaya, 2001), and are rich in n-3 polyun saturated fatty acids (Rosa and Nunes, 2003), which are considered anticholesterolemic (Krzynowek and Panunzio, 1989). On the other hand, about two-thirds of shrimp sterols are non-cholesterol sterols (Feeley *et al.*, 1972). Therefore, the use of shrimp in diets is considered valuable, especially, if they replace foods of animal origin that are high in saturated fats.

Most consumer prefer fresh or "fresh like" seafood products. However, shrimp muscle is one of the most rapidly deteriorating food products with limited shelf-life (Huidoboro *et al.*, 2002). The harvest must be cooled down to the temperature of melting ice as quickly as possible before processing into other shrimp products therefore, most of the captures are marketed in boxes with ice. (Rahman *et al.*, 2001).

Blackspot and microbial growth in fresh shrimp stored in ice are the main factors associated with quality deterioration, spoilage and economic loss (Zhuang *et al.*, 1996). Psychrotrophic bacteria are the major group of microorganisms responsible for spoilage of fresh seafoods (Gram and Huss,

1996). Shrimp contain a lot of non-protein nitrogenous compounds, easily metabolized by microorganisms (Cobb et al, 1976). One way to retard microbial growth is throught antimicrobial agents. Sodium metabisulphite has been considered as antimicrobial food additives (Lueck, 1980). It ($Na_2S_2O_5$) has a reduction effect on total bacterial and H_2S producing bacteria growth in shrimp. (Pyle and Koburger, 1984). Thus, there could be advantages to treating fresh shrimp with such food additive before processing into other shrimp products (Cadun *et al.*, 2005).

Discoloration due to melanosis is a serious problem in shrimp processing (Gokoglu, 2004). Shrimp black spot, an objectionable surface discoloration, occurs on most shrimp species and decreases the commercial value and consumer acceptance of the shrimp product (Montero *et al.*, 2001). Melanosis is caused by the endogenous shrimp enzyme polyphenol oxidase (PPO), which oxidizes phenols to quinones, followed by non-enzymatic polymerization of the quinones to pigment of high molecular weight and very dark or black coloring. The enzyme PPO remains active throughout post-harvest processing unless the shrimp are frozen or cooked (McEvily *et al.*, 1991). Melanosis defect initially occurs in appearance but increasingly spoils the flesh and therefore quality is lost (Yamagata and Low, 1995). Industry is therefore vitally interested in factors controlling these problems.

A variety of compounds have been used to act as inhibitors for melanosis. The most widely used to these are sulphites, which interfere in the polymerization of the quinones, combining irreversibly with them, and forming colorless compounds (Embs and Markakis, 1965). There are several alternatives to sulphites, but according to Smith (1980) sulphite is the cheapest and easiest quite and effective method to prevent the occurrence of melanosis. In this respect, Chen *et al.*, (1991) reported that, the number of chemicals that can actually be used in food systems to inhibit melanosis is limited by off-flavors, off-odors, toxicity, and economic feasibility. Recently, Gokoglu (2004) came to the conclusion that sodium metabisulphite was very effective than organic acids in preventing melanosis.

However, six types of sulphites are commonly used, of those sodium metabisulphite is the most used in the shrimp industry (Slattery *et al.*, 1990). Current regulations prescribe a dip treatment of 1 minute exposure in 1.25% sodium bisulphate solution with an allowable sulfite residual of 100 ppm, there is no evident risk for the general population when sulphites are used at permitted amounts (Federal Register, 1982, 1985). Due to the low residual sulfite (SO_2) on the shrimp meat (29 ppm), the taste, texture, appearance and normal development of pink color upon cooking are unaffected by dipping in $Na_2S_2O_5$ solution for one minute (Slattery *et al.*, 1990; Yamagata and Low, 1995).

Quality changes in shrimp during iced storage occur due to microbial activity and tissue enzymes (Cobb *et al.*, 1976). The most commonly used methods for assessing spoilage of seafoods are pH, trimethylamine nitrogen (TMA-N), total volatile basic nitrogen (TVB-N) and lipid deterioration (TBARS), along with sensory and microbiological analyses (Cheuk et al., 1979, Ruiz-Capillas and Moral, 2001).

We have therefore thought it to be of scientific and practical interest to study the effect of sodium metabisulphite dipping treatment (1.25% for 1 minute) on melanosis inhibition and shelf-life of marine red shrimp stored in ice for 8 days at 4-5°C. Sensory odor inspection, microbial analysis and biochemical indices of shrimp samples under investigation were included and compared with control samples (dipped in distilled water for 1 minute). Proximate composition and energy value of raw fresh shrimp were also monitored.

MATERIALS AND METHODS

Shrimp source:

Live marine red shrimp (Aristeus antennatus) were purchased directly from fishing boats in Abi-kier, Alexandria, Egypt in December, 2004. Shrimp were killed immediately in crushed ice, then transferred to the laboratory within 3 hours. Heads on, shells-on whole shrimp were used to represent the most problematic product form. Shrimp were divided into 2 groups, each 2kg (72 pieces), and kept in crushed ice until treatment.

Samples treatment:

One group was dipped in a 1.25% solution of sodium metabisulphite ($Na_2S_2O_5$) for 1 minute with moderate agitation, at a ratio of approximately 300 grams shrimp per 1 liter solution (Otwell and McEvily 1991). The second group was dipped in 0% $Na_2S_2O_5$ (distilled water) for 1 minute. The dipping solutions were kept in an ice bath to maintain a temperature close to O°C to avoid temperature differentials between the shrimp and solutions (Zhuang *et al.*, 1996). Following draining at ambient temperature (20°C) for 3 minutes the shrimp were randomly packed into polyethylene bags, three pieces of whole shrimp / sample and stored in boxes containing crushed ice for 8 days. The samples were re-iced as necessary during storage. All boxes were housed in a refrigerator at 4-5°C to slow ice melting.

Analytical Methods:

For each sampling day, three samples were used / treatment. Sensory assessment (Odor score and extent of melanosis / blackening) were performed daily on the raw whole shrimp. Every other day, biochemical indices and microbiological analysis were evaluated on finely chopped and well mixed shrimp muscles after peeling and deveining.

Proximate analysis and energy value:

Moisture, protein, fat and ash contents of raw fresh shrimp samples were measured following the procedures proposed by AOAC (1995). The percentage results were the main value of two replicates. The energy value was calculated as mentioned in Rosa and Nunes (2003).

Biochemical indices:

pH values were measured using Hanna, HI 9021 pH meter as described by Ruiz-Capillas and Moral (2001). Thiobarbituric acid reactive substances (TBARS) as mg malonaldehyde (MA)/kg flesh according to

Vyncke (1975). Total volatile basic nitrogen (TVB-N) as mgN/100g flesh as mentioned by Pearson (1981). Trimethylamine nitrogen (TMA-N) as mgN/100g flesh according to the method recommended by the AMC (1979). All analyses were performed at least in duplicate.

Microbiological analysis:

Total bacteria counts (TBCs) of the representative samples were determined according to the method described by Harrigan and Margaret (1996). The bacterial counts were expressed as mean $\log_{10}$ CFU/g sample.

Sensory Evaluation:

(1) Melanosis development:

Melanosis formation was evaluated according to the melanosis scale (Table 1) published by Otweel and Marshall (1986). Raw shrimp samples from each treatment were evaluated daily for degree of melanosis by 10-member panel. A score of 0 indicates high quality product and a score of 8 or greater represent severe melanosis defects approaching unacceptable.

Table 1. Scale for melanosis evaluation

Melanosis Scores	Description
0	Absent
2	Slight, noticeable on some shrimp
4	Slight, noticeable on most shrimp
6	Moderate, noticeable on most shrimp
8	Heavy, noticeable on most shrimp
10	Heavy, totally unacceptable

2) Odor changes:

Odor inspection of the whole raw shrimp either control or treated by sodium metabisulphite was performed daily by 10-member panel according to the method recommended by Nielsen (1995). Odor characteristic of the shrimp was scored on a scale of 0-10, with 10 representing seaweedy fresh marine odor and 0 distnict putrefied shrimp odor and lots scoring less than 4 were rejected.

RESULTS AND DISCUSSION

Proximate composition and energy value:

It is well recognized that uncontrolled variables, such as the geographical location of shellfish, season of the year, sex, feeding habits and reproductive status affect the nutrient composition of shrimp, especially marine species (King *et al.*, 1999).

Data on moisture, protein, fat and ash contents, expressed as grams (g) per 100g edible portion, of the raw marine red shrimp are presented in Table 2. The proximate analyses are within the normal limits for the species and season and are in agreement with those found in the shellfish literature (King *et al.*, 1990; Bragagnolo and Rodriguez-Amaya, 2001; Rosa and Nunes, 2003).

Table 2 also reveals that shrimp are characterized by a high protein (21.7%) and ash (2.1%) contents and very low fat content (0.43%). Added to these merits is the low energy value based on protein and fat contents of raw red marine shrimp. (96.54 K calorie/100g = 403.92 kj/100g), the moisture / protein ratio (3.41) also reflect good quality of shrimp meat (Pearson, 1981). These results confirmed the findings obtained by Huidobro *et al.*, (2002); Rosa and Nunes (2003); Cadun *et al.*, (2005). Based on proximate analyses and energy value of red marine shrimp (Table 2), consumption of shrimp is therefore being encouraged.

Table 2: Proximate composition and energy value of raw fresh marine red shrimp (% wet weight basis).

Constituents	On fresh wet basis
Moisture %	74.05
Protein %	21.7
Fat %	0.43
Ash %	2.10
Moisture/ Protein ratio	3.41
Caloric value*	
K calorie /100g	96.54
KJ / 100g	403.92

* Caloric value = g. protein x 4.27+ g. fat x 9.02 (1 K calorie = 4.184 K.J)

Quality changes during iced storage:

pH Changes:

pH values of shrimp samples as affected by sulphite dipping treatment and iced storage for 8 days are illustrated in Fig.1, from which it is apparent that the initial pH value of control shrimp was 6.72, while treated shrimp exhibit slightly higher pH value (6.78). From the same results illustrated in Fig.1, it is clear that, pH values for control red shrimp stored in ice increased progressively throughout the experiment and reached figures of 6.91, 7.23, 7.48 and 7.80 after 2,4, 6 and 8 days; respectively. However, increases in pH are related to the accumulation of basic substances, such as ammonia and trimethylamine (TMA) produced by microbial development in shrimp muscle (Chang *et al.*, 1983). Fig 1 also reveals that sulphite treated shrimp samples showed lower pH values throughout the experiment reached figure of 7.30 after 8 days of iced storage. The lower pH values for treated samples could be explained in the basis of antimicrobial property of sodium metabisulphite (Lueck, 1980).

In this respect, Huidobro *et al.*, (2002) reported that the initial pH value of shrimp muscle was 6.93, thereafter it reached 7.29 after 4 days of iced storage. A pH of 7.4 for zero-day of storage was reported by Flores and Crawford, (1973). They also mentioned a pH of 8.4 after 8 days of iced storage. Rahaman *et al.*, (2001) came to the conclusion that pH value of brackish water prawn increased from 6.63 to 7.28 during 10 days of iced storage. Recently, Gokoglu, (2004) reported that the initial pH value of shrimp muscle was 7.1 and reached 7.5, 7.7 and 7.95 after 2,4 and 6 days of refrigerated storage at 4°C.

The pH of shrimp and prawn has been suggested as a good index of freshness (Cadun *et al.*, 2005). It was reported that pH of shrimp muscles increased with time and temperature (Shamshad and Co-Workers, 1990), and they noted a relationship between pH and acceptability. On the basis of sensory evaluation the pH value above 7.3 was found unacceptable for consumption or spoiled (Rahaman *et al.*, 2001). On the other hand, Cheng and Lain, (1979) reported that pH 7.8 was a critical margin for acceptability. According to these criteria, our shrimp samples treated with sodium metabisulphute were of good quality throughout the storage, whereas the control samples were of good quality up to 4 days (Fig.1).

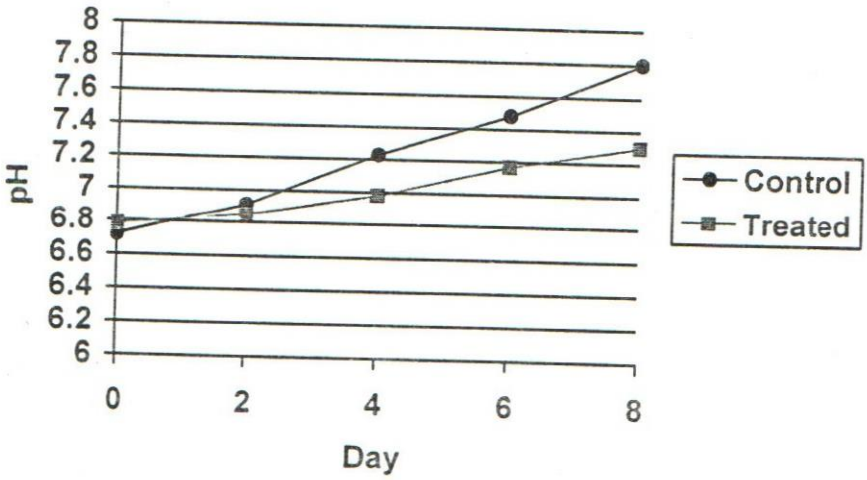

Fig. 1: Changes in pH values of control and $Na_2S_2O_5$- treated red shrimp during ice storage.

Trimethylamine nitrogen (TMA-N) changes:

Crustaceans contain considerable trimethylamine oxide (TMAO), which is broken down to trimethylamine (TMA) by psychotropic bacterial enzymes (Yamagata and Low, 1995). Changes of TMA-N values of control and $Na_2S_2O_5$- treated ice- stored red shrimp were compared (Fig.2). The TMA-N of control shrimp increased from 0.45 mg/100g on 0-day to 1.89, 4.35, 6.13 and 8.24 mgN/100g on day 2,4,6 and 8 of ice storage; respectively. Similar trend of changes in TMA-N of control shrimp was observed by Gokoglu (2004), who reported that TMA-N of control shrimp increased from 0.05 to 9.1 mgN/100g during 6 days of refrigerated storage at 4°C.

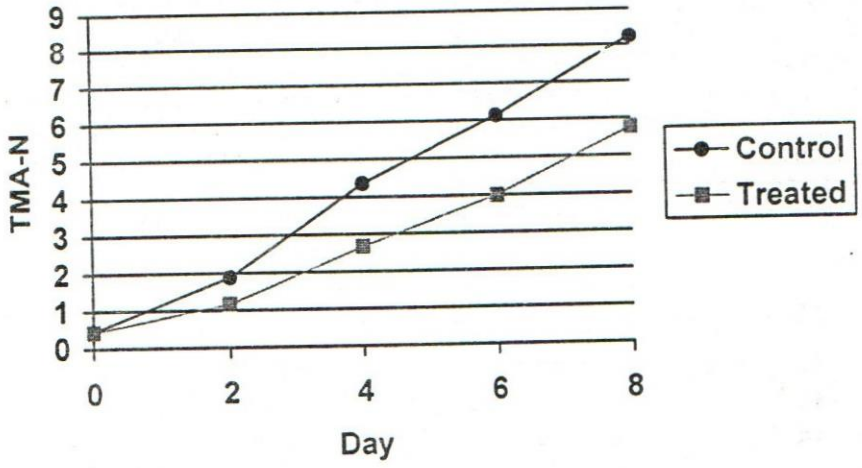

Fig. 2: Changes in TMA-N (mgN/100g) values of control and $Na_2S_2O_5$-treated red shrimp during ice storage.

Fig. 2 also reveals that, for $Na_2S_2O_5$ – treated shrimp, the TMA-N values of the 0-day, 2,4,6 and 8 days were 0.43, 1.17, 2.67, 4.00 and 5.76 mgN/100g ; respectively. However, the lower TMA-N values of sulphite – treated shrimp could be due to the antibacterial effect of $Na_2S_2O_5$ (Pyle and Koburger, 1984). The present study confirmed the findings of Yamagat and Low (1995), who reported that the TMA-N levels of control shrimp were higher than that of the sulphite treated shrimp under the same conditions. In this respect, Huidobro *et al.*, (2002) pointed out that TMA-N levels increased from 0.47 mgN/100 g after 1 day to 2.91 mgN/100g after 4 days of ice-stored shrimp pre-treated with sulphite.

TMA-N is well documented as a product of bacterial spoilage (Gram and Huss, 1996), a level of 5mgN/100 is the limit of acceptability of shrimp (Cobb *et al.*, 1976; Gokoglu, 2004). Consequently control shrimp samples under investigation were of acceptable quality up to 4 days as compared to 7-8 days for sulphite – treated shrimp (Fig.2). This was also seen in the pH study (Fig.1).

Total volatile basic nitrogen (TVB-N) changes:

TVB-N production is the combined result of tissue enzymes and microbial activity (Cheuk *et al.*, 1979). Changes in TVB-N of control and treated shrimp samples during iced storage are shown in Fig.3, from which it is apparent that the initial average TVBN value for control sample was 17.4 mgN/100g flesh. TVB-N level detected in red shrimp samples are close to others referred in fresh shrimp samples (Huidobro *et al.*, 2002; Gokoglu, 2004).At the beginning of iced storage. TVB-N showed slightly higher value in control samples than sulphite – treated samples.

Fig.3 also reveals that during iced storage TVB-N value of all samples gradually increased with a higher rate in control shrimp than in sulphite-treated shrimp. Similar trend of changes was obtained by Gokoglu (2004), who reported that TVBN value increased from 18.29 mg/100g to more than 30 mg/100g after 4 days of refrigerated storage. Also, Yamagata and Low (1995), pointed out that control banana shrimp showed higher TVB-N values than sulphite – treated samples during 8 days of iced-storage. Rahaman et al (2001) came to the conclusion that TVB-N of brackish water prawn increased from 5.88 mg/100g to 32.76 mg/100g after 10 days of iced storage.

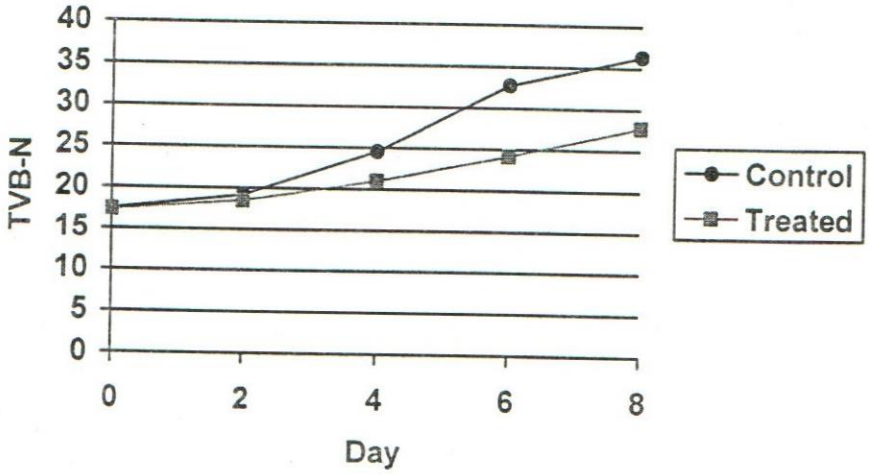

Fig. 3: Changes in TVB-N(mgN/100g) values of control and $Na_2S_2O_5$-treated red shrimp during ice storage.

Fig.3 showed differences levels of TVB-N according to storage time and sulphite treatment. However, a level of 30 mgN/100g has been considered the upper limit above which fishery products are considered unfit for human consumption (Cobb *et al.*, 1976; Connell, 1995). As shown in fig. 3 control shrimp kept in ice were acceptable for 4 days compared to 8 days for treated samples. The general lower pH, TMA-N and TVB-N values in treated samples as compared to control samples, indicated that $Na_2S_2O_5$ treatment slowed spoilage in red shrimp samples. These results confirmed the findings reported by Yamagata and Low (1995) for banana shrimp treated with bisulphate and stored in ice for 8 days.

Thiobarbituric acid reactive substances (TBARS) changes:

TBARS analysis is an important quality index, indicating fat oxidation. The TBARS values of red shrimp samples as affected by sulphite treatment and iced-storage for 8 days are shown in Fig.4. From which it is apparent that, the initial TBARS for control and treated shrimp were 0.46 and 0.42 mg MA/Kg; respectively. These values are in line with those obtained by Cadun

et al., (2005). TBARS values of both samples gradually increased during iced storage reached figures of 1.08, 1.84, 2.34 and 3.7 mg MA/Kg in control samples after 2,4,6 and 8 days; respectively. On the other hand, treated shrimp exhibit lower values of TBARS being 0.78, 1.23, 1.90 and 2.40 under the same conditions; respectively. Sodium metabisulphite from its multi functions properties inhibits shrimp pigments from oxidation and consequently reduces TBARS values (Fig.4).

Concerning TBARS of shrimp samples, it is worth mentioning that, fish and fish products of good quality will have TBARS values less than 2 mg MA/kg, while consumption limits should be less than 5 mg MA/Kg (Bonnell, 1994 ; ES. 2005). However, shrimp samples well below the acceptability limits. Treated samples were of good quality up to seven days, whereas control samples exhibit good quality up to 4 days (Fig.4). Generally, the lower TBARS values in all samples (Fig.4) is related to low fat content of shrimp samples (Table 2). The results of TBARS confirmed the findings of Rahaman *et al.*, (2001) who reported that shrimp samples exhibit acceptable peroxide values during 10 days of iced-storage.

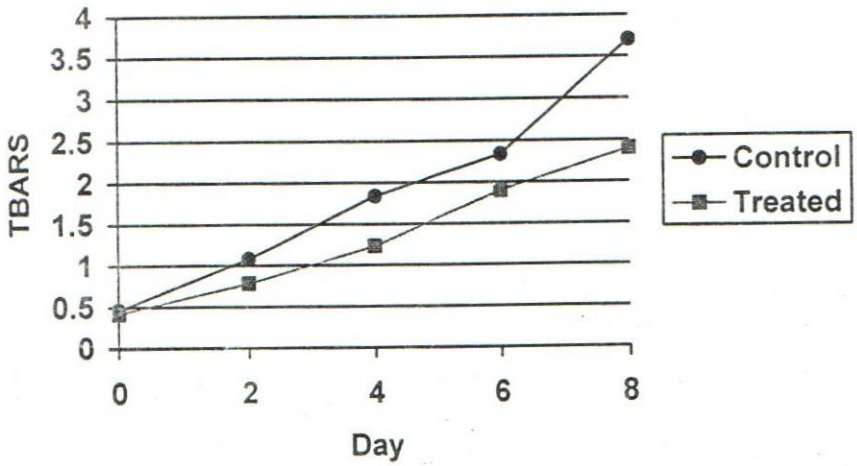

Fig. 4: Changes in TBARS mg MA /Kg flesh of control and $Na_2S_2O_5$-treated red shrimp during ice storage.

Bacterial Analysis:

Total bacteria counts (TBC) in control and sulphite – treated shrimp sample are presented in Fig.5. the results indicated that initial counts of TBC in raw fresh control red shrimp was 4.13 log $CFUg^{-1}$. The lower initial value of TBC showing that a correct handling was performed after catching and that products were microbiologically of high quality. Counts of TBC, around 4.5-5.24 log $CFUg^{-1}$, in shrimp stored at O°C on the day of catch have been reported (Rahman *et al.*, 2001; Cadun *et al.*, 2005). In relation to this, Chang *et al.*,(1983),refer that shrimp initially presenting 10^5 $CFUg^{-1}$ and 18mg TVBN/100g are of good but not of prime quality.

Fig. 5 also demonstrates that microbial load decreased to 3.62 log $CFUg^{-1}$ just after the shrimp were dipped in 1.25% $Na_2S_2O_5$ for one minute. In this respect, Pyle and Koburger (1984) reported that microbial numbers were reduced immediately by as much as 50% after dipping shrimp in a sodium bisulphate solution. Huidobro et al (2002) also reported that the initial TBC of raw fresh shrimp sample pre-treated with sulphite was 2.7 log $CFUg^{-1}$. Sodium metabisulphite has been considered as an antimicrobial food additives (Lueck, 1980).

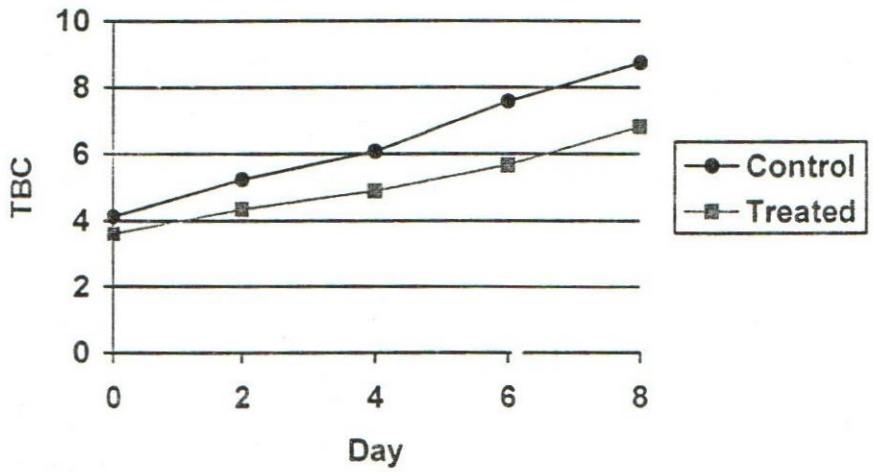

Fig. 5: Changes in TBC log $CFUg^{-1}$ of control and $Na_2S_2O_5$- treated red shrimp during ice storage.

Fig. 5 further shows that TBCs of control shrimp samples markedly increased during iced storage reaching figures of 5.24, 6.08, 7.58 and 8.73 log $CFUg^{-1}$ afte: 2,4,6 and 8 days of iced storage, respectively. These results confirmed the findings obtained by (Zhuang *et al.*, 1996; Rahman *et al.*, 2001). On the other hand, treated shrimp samples exhibit quite low TBCs that reached figures of 4.35, 4.90, 5.67 and 6.82 log $CFUg^{-1}$ after 2,4,6 and 8 days of iced storage; respectively, similar results were achieved in shrimp samples pre-treated by sulphite (Pyle and Koburger, 1984; Huidolor *et al.*, 2002).

Concerning the shelf-life of crustaceans, in general 10^6-10^8 bacteria/g is defined as an onset of spoilage population for shrimp (Simpson *et al.*, 1997). Thus , the shelf- life of control shrimp was 4 days compared to 7 days for sulphite-treated shrimp stored in ice (Fig.5). The results of microbiological quality confirmed the results of biochemical indices previously discussed in red shrimp samples and also confirmed the findings achieved by Gokoglu (2004).

Sensory Evaluation:

(1) Melanosis development:

Blackspot occurs on most shrimp species and decreases the commercial value and consumer acceptance (Montero *et al.*, 2001). Mean melanosis scores of control and sulfite-treated shrimp stored in ice for 8 days are given in Table 3. From which it is apparent that, blackspot developed rapidly in control samples exceeding the target limit score of 4 after 3 days storage time. A score of 4 for extent of melanosis in 3-4 days has also been reported for shrimp (Otwell and Marshall, 1986; Otwell *et al.*, 1992; Montero *et al.*, 2001). However, melanosis is caused by the endogenous shrimp enzyme PPO, which oxidizes phenols to quinines, followed by non-enzymatic polymerization of the quinones to pigment of high molecular weight and very dark or black coloring (Lee-Kim *et al.*, 1997).

Concerning melanosis scores, it is worth mentioning that a score of 4 or less indicated high quality product with minimal melanosis. Ascore between 4 and 10 was considered indicative of shrimp with measurable quality defects. Ascore of 8 or greater represented severe defects, approaching unacceptable (Otwell and Marshall, 1986; McEvily *et al.*, 1991).

Data presented in Table 3 further shows that control samples exhibit slight melanosis noticeable on some shrimp in the head and gill region, for the first 2 days of storage. On the third day, control samples developed slight blackening (4.3) noticeable on most shrimp (30-40% of shrimp surface affected). By day 4, over 75% of shrimp heads were dark with moderate blackening (6) in the tail and body (50-60% of shrimp surface affected). On the 5th day, control samples exhibit heavy blackening (8.4) on most shrimp (60-80% of shrimp surface affected and, consequently were considered unacceptable. After 6 days of iced-storage control samples showed extremely heavy blackening (9.3) on all shrimp (80-100% of shrimp surface affected), the entire shrimp was very poor quality. At the end of storage time, control samples showed very poor quality (10), indicating advanced stage of protecolysis. In this respect, Gokoglu (2004) reported that control shrimp were judged unacceptable (based on melanosis scores) after 4 days compared to 6 days for sulfite – treated shrimp.

On the other hand, the results in Ttable 3 indicated that $Na_2S_2O_5$ had a strong effect on delaying melanosis development in shrimp. This could be explained in the basis that sulphites can inhibit PPO activity also, sulfites interfere in the polymerization of the quinones, combining irreversibly with them and forming colorless compounds (Embs and Markakis, 1965). However, the bisulphate – dipped samples exceed the target limit score of 4 after 6 days of storage (Table 3). These results confirmed the findings obtained by Otwell and McEvily (1991).

Referring to Table 3, it is quite clear that sulphite – treated shrimp had developed slight melanosis in the head and body after 6 days of storage. By day 7, though only moderate blackening was observed for the whole shrimp. At the end of the trial period treated shrimp were rejected because of reddening in the gut region (an indicative of advanced spoilage) as well as to the higher melanosis scone (8.0). However, blackening occurance in treated samples in the late period of storage could be due to oxidation of sulphites

(Lee-Kim *et al.*, 1997). These results coincide with those obtained by Yamagata and low (1995); Gokoglu (2004) who reported that $Na_2S_2O_5$ treated shrimp stored in ice has extended shelf-life compared to untreated control.

Table (3):Melanosis score of control and sulphite-treated shrimp during iced-storage

Iced-Storage (Day)	Control	Treated
1.	2.2 ± 0.15	0.00
2.	3.5 ± 0.12	0.00
3.	4.3 ± 0.19	2.1 ± 0.14
4.	6.0 ± 0.27	2.8 ± 0.29
5.	8.4 ± 0.30	3.6 ± 0.29
6.	9.3 ± 0.26	4.8 ± 0.44
7.	10.0 ± 0.00	6.1 ± 0.22
8.	10.0 ± 0.00	8.0 ± 0.51

(All values reflect the mean and standard deviation, n = 10)

(2) Odor Changes:

Product odor has become a major factor in grading and evaluation the quality of fish and shelf fish (Nielsen, 1995). Mean scores for sensory assessment of odor during iced storage of control and treated shrimp are shown in Table 4. From which it is clear that mean odor scores decreased as the time of storage progressed. However, control shrimp stored in ice retained their characteristic fresh seaweedy odor for the first 2 days of storage. On the third day of ice storage the odor score of control samples slightly decreased indicating loss of fresh odor intensity, in other words control samples exhibit a weak marine odor. By day 4, control samples developed a slight ammonical and fishy odor, which could be attributed to the reaction between TMA and shrimp fat (Yamagata and Low, 19995). On the 5th day of iced storage a distinct ureal odor was detected in control samples, accordingly samples were considered unacceptable. After 6 days of storage control samples exhibit severe off-odor and it probably coincides with the onset of spoilage and the logarithmic phase of microbial growth (Fig.5). Thereafter, the odor score sharply decreased indicating very poor quality.

Table 4 also reveals that, the $Na_2S_2O_5$ – treated shrimp stored in ice retained their characteristic fresh seaweedy odor for the first 4 days storage.

Table 4:Odor score for control and sulphite-treated red shrimp during iced-stroage.

Iced-Storage (Day)	Control	Treated
1.	9.0 ± 0.58	9.0 ± 0.45
2.	8.3 ± 0.37	8.6 ± 0.43
3.	7.1 ± 0.29	8.1 ± 0.48
4.	5.4 ± 0.34	7.8 ± 0.33
5.	4.0 ± 0.47	[illegible] ± 0.27
6.	3.0 ± 0.36	6.6 ± 0.35
7.	1.8 ± 0.35	5.7 ± 0.27
8.	1.0 ± 0.53	4.3 ± 0.31

(All values reflect the mean and standard deviation, n = 10)

The odor changed to slightly ammonical and slightly fishy on day 7. At the end of the trial period treated shrimp developed a distinct ureal odor that makes samples unacceptable. These results are in agreement of those obtained by Yamagata and Low (1995) in banana shrimp pre-treated with sulphites and stored in ice for 8 days.

Conclusions:

This study has demonstrated the effectiveness of sodium metabisulphite as an agent in delaying melanosis development in red shrimp. Its antimicrobial effect was confirmed. Based on biochemical indices, microbiological and sensory analyses, a one minute dip into 1.25% $Na_2S_2O_5$ solution is sufficient to delay blackspot and maintain a high quality shrimp product for at least 7 days storage in ice compared to only 4 days for control samples.

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إطالة مدة حفظ الجمبري الأحمر وتحسين جودته أثناء التخزين في الثلج

روبيل كامل معوض
المركز القومي للبحوث – قسم الصناعات الغذائية – الدقي – مصر

البقع السوداء التي تنتشر سريعا في معظم أنواع الجمبري أثناء حفظه في الثلج تقلل من قيمته التجارية وتخفض من قابلية المستهلك علي مثل هذه المنتجات – لذا أجري هذا البحث بفرض تقييم تأثير غمر الجمبري الأحمر في محلول تركيزه ١,٢٥ % صوديوم ميتا باي سلوفيت لمدة دقيقة واحدة ثم التصفية والتعبئة والحفظ في الثلج لمدة ٨ أيام داخل الثلاجة (٤-٥°م) علي خصائص جودة الجمبري ومدة حفظه في الثلج وكذا منع الأسوداد الحادث .

أكدت النتائج أن الأسوداد يحدث سريعا في عينات الكنترول (المغمورة في ماء مقطر لمدة دقيقة واحدة) مما يجعلها غير مقبولة بعد ٤ أيام من الحفظ في الثلج (حسب التقييم الحسي لدرجة الأسوداد) . وترجع مدة الحفظ القصيرة إلي ارتفاع قيم دلالات التحليل الكيماوي وإلي زيادة الحمل الميكروبي الذي يؤثر بدوره في سرعة تكوين المركبات المسئولة عن الرائحة غير المرغوبة والدالة علي حدوث تحلل وفساد في عينات الجمبري .

وعلي جانب أخر فإن غمر الجمبري في محلول ١,٢٥% صوديوم ميتا باي سلوفيت لمدة دقيقة واحدة حسب التوصيات الحديثة أخرت بوضوح ظهور البقع السوداء وقللت من تكوين المركبات القاعدية الكلية الطيارة وكذا نتروجين ثلاثي الأمين . وأيضا أدت المعاملة إلي خفض ملحوظ في الحمل الميكروبي وقللت من الارتفاع الحادث في درجة تركيز أيون الأيدروجين (الأس الأيدروجيني) وحمض الثيوباربتيوريك . كما أظهرت نتائج التقييم الحسي تأخر ظهور الرائحة غير المرغوبة المصاحبة لفساد الجمبري وعليه تمتد فترة الصلاحية في العينات المعاملة والمحفوظة في الثلج إلي سبعة أيام . وهذا يعني أن غمر الجمبري لمدة دقيقة واحدة في محلول ١,٢٥% صوديوم ميتا باي سلوفيت كان كافيا لتأخير ظهور عيوب الأسوداد ويبقي منتجات الجمبري في درجة جودة عالية لمدة طويلة (٧ أيام) .