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Abstract

The data represented in this paper describe techniques, methodologies and data obtained during the biochemical characterization of Blackspot Snapper (Ehrenberg's Snapper). Data analysis of protein, lipids, moisture, ash contents of Ehrenberg's snapper, total polyphenols, total flavonoids contents and the DPPH scavenging activities of Cinnamon (Cinnamomum verum J. Prest) bark (50 mg/50 g), cumin (Cuminum cyminum L.) (50 mg/50 g), turmeric (Curcuma longa L.) (50 mg/50 g), garlic (Allium sativum L.) (50 mg/50 g), ginger (Zingiber officinale Roscoe) (50 mg/50 g) and Vitamin C (25 mg/50 g) are represented. Data obtained from the Infrared spectroscopy (FTIR) analysis of the six spices and vitamin C treated and stored fillets at −25 °C, namely three vibrations, Amide A, NH stretching at 3300 cm⁻¹; Amide I, C=O stretching 1600–1690 cm⁻¹ and Amide II, CN stretching and NH bending at 1480–1575 cm⁻¹. Differential scanning calorimetry (DSC) analysis data of three main denaturations; myosin, actin and sarcoplasmic proteins are presented.

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Here we report experimental data on proteins' denaturation of Ehrenbergs' Snapper (*Lutjanus ehrenbergii*) locally known as (*Naiser*) which fall within the green category according to the consumer guide produced by Emirates Wildlife Society, in association with the World Wide Fund for Nature (EWS-WWF) [2]. This guide helped in the identification of more sustainable species.

Calibration curves for assays for polyphenols, flavonoids contents and DPPH scavenging activity of garlic, ginger, cumin, turmeric and cinnamon are presented in (Figure S1, S2 and S3 respectively, included in Supplementary documents). While data, of total phenolic contents presented in mg (gallic acid)/100 g (dry weight of biomass), flavonoids presented as ppm of rutin and DPPH scavenging activity given in inhibition (%), are given in Table 1. Fish samples were prepared using protocol shown in Fig. 1. The biochemical characterization of Ehrenberg snapper includes; lipids content, peroxide value, moisture content, ash analysis, proteins content are presented in Fig. 2. The metal content of ash are represented in Table 2. The effect of 50.0 mg biomass/50 g mince

### Value of the Data
- The research represents a very useful data for proteins' denaturation inhibition by using natural antioxidants.
- These data are relevant to food conservation, especially sustainable fish species and provide more understanding of factors affecting proteins' denaturation.
- These data gave a detailed and complete set of experiments that could be used in the characterization of various fish species and provide an insight on how gels, pastes and surimi could be prepared from seafood.
- The data reveal new ways in which widely used natural antioxidants presumably used to inhibit protein denaturation and develop more sustainable and innovative products from widely available stocks of fish and save overfished categories.

### 1. Data

Here we report experimental data on proteins' denaturation of Ehrenbergs' Snapper (*Lutjanus ehrenbergii*) locally known as (*Naiser*) which fall within the green category according to the consumer guide produced by Emirates Wildlife Society, in association with the World Wide Fund for Nature (EWS-WWF) [2]. This guide helped in the identification of more sustainable species. Calibration curves for assays for polyphenols, flavonoids contents and DPPH scavenging activity of garlic, ginger, cumin, turmeric and cinnamon are presented in (Figure S1, S2 and S3 respectively, included in Supplementary documents). While data, of total phenolic contents presented in mg (gallic acid)/100 g (dry weight of biomass), flavonoids presented as ppm of rutin and DPPH scavenging activity given in inhibition (%), are given in Table 1. Fish samples were prepared using protocol shown in Fig. 1. The biochemical characterization of Ehrenberg snapper includes; lipids content, peroxide value, moisture content, ash analysis, proteins content are presented in Fig. 2. The metal content of ash are represented in Table 2. The effect of 50.0 mg biomass/50 g mince
2 Kg of Ehrenberg’s Snapper purchased from Al-Jubail fish market Sharjah, were gutted, cleaned, made into fillets and then minced. After mincing, the mass was 845.0 g.

1. The first made by 7 portions of 56.0 g marinated with 33.0 mL of antioxidant water extract.
2. The second batch was for Lipid analysis made by weighing 56.0 g without treatment.
3. The third batch was for protein analysis, made by weighing 56.0 g without treatment.
4. The fourth batch was kept as reference, made by weighing 56.0 g without treatment.

Table 1
Total phenolic contents in mg (GAE)/100 g (DW), total flavonoids contents and DPPH radical scavenging activity of garlic, ginger, cumin, turmeric, and cinnamon.

| Antioxidant | mg (GAE)/100 DW | DPPH (inhibition) % | 1.0 mg/mL | 1.0 mg/mL | 0.5 mg/mL |
|-------------|-----------------|--------------------|-----------|-----------|-----------|
| Garlic      | 3.73 ± 0.01     | 89.87%             | 26.13 ± 0.01 | 1.80 ± 0.001 | 0.58 ± 0.31 |
| Ginger      | 5.92 ± 0.02     | 80.45%             | 62.04 ± 0.02 | 4.28 ± 0.01  | 1.39 ± 0.07 |
| Cumin       | 13.26 ± 0.01    | 7.086%             | 129.46 ± 0.05 | 8.93 ± 0.01  | 2.89 ± 0.15 |
| Turmeric    | 20.34 ± 0.01    | 90.50%             | 70.85 ± 0.03 | 4.89 ± 0.01  | 1.58 ± 0.08 |
| Cinnamon    | 37.93 ± 0.19    | 90.54%             | 44.51 ± 0.02 | 3.07 ± 0.001 | 0.99 ± 0.05 |

Fillets treated with cinnamon, cumin, turmeric, garlic, ginger and 25.0 mg of vitamin C was studied to assess protein denaturation during a period of 4 weeks storage time at −25.0 °C. FT-IR stretching vibration of Amide-A (vNH) at 3300 cm⁻¹; Amide-I stretching (vC=O) between 1600 and 1690 cm⁻¹ and Amide-II stretching (vCN) and bending (δNH) between 1480 and 1575 cm⁻¹ were used as marker peaks, these are presented from Fig. 3. Averages of transmittances of the marker peaks run in triplicate for different antioxidant treated and non-treated samples frozen at −25 °C for 1 week, 2 weeks, 3 weeks and 4-weeks storage time were summarized in Table 3. Descriptive analysis one-way ANOVA and pair-wise comparison of mean values of different variables obtained from Table 3 and summarized in Table S1 (in Supplementary material) were performed using SPSS 15.0 version, the t-test were used with a significant level of p < 0.05. The data are presented from Table S2 to Table S3 (Supplementary material). In Table S1, is presented the statistical coding of different variable. For instance, the outputs of the first week, Amide A is denoted by V13A1, V13A2

Fig. 1. Protocol and mincer machine used for the preparation of 845.0 g of Ehrenberg snapper’s mince fillets which was divided into 56.0 g boxes to make four different batches.
V13A3, V13A4, V13A5, V13A6, V13A7, respectively, where 13 denotes first week and numbers from 1 to 7 denote antioxidants; reference, cinnamon, garlic, ginger, turmeric, cumin and vitamin respectively. Similar coding was used for other weeks. Comparison was made in two different ways; a horizontal comparison to assess the effect of antioxidant, the t-test in this case was performed with a reference variable V13A1 and all other variables V13A2 V13A3 V13A4 V13A5 V13A6 V13A7, the code used in SPSS to calculate p values in this case is given as Code 1. While the vertical comparison was made to assess the effect of time, in this case comparison was made through the same categories; amide A (week-1) with amide A (week-2). The code used in this case is presented as Code 2. We finally analyzed the effect of 50.0 mg biomass/50 g mince fillets treated with cinnamon, cumin, turmeric, garlic, ginger and 25.0 mg of vitamin C on protein denaturation during a period of 4 weeks and storage time of −25.0 °C using DSC, three marker peaks were followed, myosin, sarcoplasmic proteins and actin. Thermograms are represented in Fig. 4, peaks (°C) and enthalpies (J/g) obtained for different antioxidants treated mince fillets from DSC are summarized in Table 4.

![Fig. 2. Composition of Ehrenberg's Snapper black spot fish.](image)

**T-TEST**

PAIRS = V13A1 V13A1 V13A1 WITH V13A2 V13A3 V13A4 V13A5 V13A6 V13A7 (PAIRED)

/CITERIA = CI (0.95)

**Code 1**

**T-TEST**

PAIRS = V13A1 V13A1 V13A1 WITH V20A1 V27A1 V04M1 (PAIRED)

/CITERIA = CI (0.95)

/MISSING = ANALYSIS.

**Code 2**
2. Experimental design, materials, and methods

2.1. Natural antioxidant extraction

Natural antioxidants, cinnamon sticks, cumin seeds, ginger powder, turmeric powder and fresh garlic paste were purchased from the local market of Aljubail, Sharjah, the United Arab Emirates. Cinnamon sticks, cumin seeds were grided while fresh garlic was crushed in a mortar to get a past. 5.0 g of each spice were extracted with 100 mL of water or methanol in 250 mL conical flasks which were left

![FTIR spectra](image)

**Fig. 3.** FTIR for frozen (−25.0 °C) Ehrenberg’s Snapper treated with; 50 mg garlic; 50 mg cinnamon; 50 mg cumin; 50 mg turmeric; 50 mg garlic; 50 mg ginger; and 25.0 mg of vitamin C per 50 g of mince fillets; and without antioxidant for control after (A) 1 week, (B) 2 weeks, (C) 3 weeks and (D) 4 weeks’ time.
| Date       | Peak type         | Reference | Cinnamon | Garlic | Ginger | Turmeric | Cumin     | Vitamin C |
|------------|-------------------|-----------|----------|--------|--------|----------|-----------|-----------|
|            |                   | v(cm⁻¹)   | v(cm⁻¹)  | v(cm⁻¹)| v(cm⁻¹)| v(cm⁻¹)  | v(cm⁻¹)   | v(cm⁻¹)   |
|            |                   | Trans     | Trans    | Trans  | Trans  | Trans    | Trans     | Trans     |
| Week-1     | Amide A 3300 NH   | 3299.944  | 0.50538  | 0.46547| 0.57581| 0.46575  | 0.59054   | 0.48834   |
|            | stretch           | ±0.0134   | ±0.066   | ±0.074 | ±0.027 | ±0.005   | ±0.015    | ±0.027    |
|            | Amide I 1600–1690 | 1634.953  | 0.56936  | 0.59969| 0.64828| 0.57338  | 0.58004   | 0.61003   |
|            | C=O stretch       | ±0.029    | ±0.042   | ±0.059 | ±0.029 | ±0.096   | ±0.051    | ±0.051    |
|            | Amide II 1480–1575| 1549.128  | 0.72951  | 0.73186| 0.78289| 0.75324  | 0.66201   | 0.73206   |
|            | CN stretch        | ±0.028    | ±0.018   | ±0.003 | ±0.003 | ±0.027   | ±0.005    | ±0.005    |
|            | NH bending        |           |            |        |        |          |           |           |
| Week-2     | Amide A 3300 NH   | 3299.943  | 0.47734  | 0.49232| 0.48294| 0.47704  | 0.5124    | 0.48852   |
|            | stretch           | ±0.018    | ±0.024   | ±0.003 | ±0.044 | ±0.039   | ±0.027    | ±0.027    |
|            | Amide I 1600–1690 | 1634.952  | 0.59334  | 0.56349| 0.58094| 0.5283   | 0.46859   | 0.58063   |
|            | C=O stretch       | ±0.018    | ±0.024   | ±0.003 | ±0.003 | ±0.039   | ±0.018    | ±0.027    |
|            | Amide II 1480–1575| 1549.128  | 0.69048  | 0.682   | 0.70426| 0.68916  | 0.59117   | 0.67083   |
|            | CN stretch        | ±0.005    | ±0.024   | ±0.005 | ±0.021 | ±0.044   | ±0.039    | ±0.039    |
|            | NH bending        |            |            |        |        |          |           |           |
| Week-3     | Amide A 3300 NH   | 3299.943  | 0.49085  | 0.78459| 0.43806| 0.49528  | 0.4808    | 0.47885   |
|            | stretching        | ±0.01     | ±0.007   | ±0.006 | ±0.006 | ±0.006   | ±0.005    | ±0.002    |
|            | Amide I 1600–1690 | 1634.952  | 0.55516  | 0.53463| 0.53385| 0.53669  | 0.48196   | 0.54212   |
|            | C=O stretch       | ±0.008    | ±0.077   | ±0.007 | ±0.009 | ±0.063   | ±0.055    | ±0.022    |
|            | Amide II 1480–1575| 1634.953  | 0.60716  | 0.67242| 0.60292| 0.68625  | 0.52599   | 0.73035   |
|            | CN stretch        | ±0.039    | ±0.084   | ±0.153 | ±0.081 | ±0.016   | ±0.051    | ±0.046    |
|            | NH bending        |            |            |        |        |          |           |           |

Average transmittance of antioxidant treated and non-treated samples and frozen at –25 °C at 1 week, 2 weeks, 3 weeks and 4-weeks storage timing.
| Week-4 Amide A 3300 NH stretch | 2999.558 | 0.8337 | 3299.944 | 0.45725 | 3299.944 | 0.41108 | 3299.944 | 0.45225 | 2999.559 | 0.78016 | 3299.944 | 0.46918 | 2999.559 | 0.77868 |
| Amide I 1600–1690 C=O stretch | 1634.953 | 0.65331 | 1634.953 | 0.66455 | 1634.953 | 0.61647 | 1634.953 | 0.65523 | 1633.52 | 0.49238 | 1634.953 | 0.64657 | 1633.522 | 0.58776 |
| Amide II 1480–1575 CN stretch, NH bending | 1549.128 | 0.79449 | 1574.876 | 0.75328 | 1549.128 | 0.68594 | 1575.059 | 0.74015 | 1550.559 | 0.7023 | 1550.559 | 0.74433 | 1549.128 | 0.30511 |
in horizontal mechanical shaker for a period of 2 hours at 80 °C. The spice extract were filtered on an 11.0 μm pore size Whatman filter, the filtrates were dried on a rotary evaporator and 150 mg obtained powders were dissolved in 100 mL of water or methanol and transferred to amber bottles and stored in the fridge for further analysis. 50 mg of vitamin C however were dissolved in water or methanol were used as synthetic antioxidant reference. Methanol extracts were used for tests of total polyphenols analysis, total flavonoids analysis and DPPH scavenging activity, while water extracts were used for the
marinating of the fish sample to study the effect of antioxidant on the protein denaturation inhibition in Ehrenberg’s snapper.

2.2. Total phenolic contents

Total phenolic contents in garlic, ginger, cumin, turmeric and cinnamon were determined by using the protocol described in Ref. [3]. 1.00 mL of natural antioxidant (spice) containing 1.00 mg/mL of dry mass of spice were mixed with 1.0 mL of Folin–Ciocalteu’s phenol. The solution was incubated for 5 min at 23.0 °C, then 10.0 mL of a 7.00 (m/V)% sodium carbonates (Na2CO3) solution were added to the mixture. 13.0 mL of deionised water was added to the mixture to diluted it and was shaken with the rotamixer for a period of 1.0 min. The reaction mixture was kept in the dark at a temperature of 23.0 °C for 90 minutes then absorbances were measured at 750 nm using a spectrophotometer (UV-2510TS−Labomed). The same procedure was followed for the standard of pure gallic acid with concentrations ranging from 25.0 to 400 mg/L. Results were expressed in mg of gallic acid equivalent per 100 g of sample dry mass (mg (GAE)/100 g DW).

2.3. Total flavonoids content

Rutin was used to construct the calibration curve to measure the contents of spices in flavonoids, a standard curve of rutin in the range of 10.0–80.0 ppm was prepared from 400 ppm stock solution. Flavonoids were measured according to the method described by Ref. [4]. 0.300 mL of each methanolic extract (stock solution, 150.0 mg/100 mL) of natural antioxidant (spice) were introduced into 10.0 mL test tubes and were mixed separately with 3.40 mL of 30.0 (v/v)% methanol, 0.15 mL of 0.50 M sodium nitrate (NaNO2) and 0.15 mL of 0.30 M aluminium chloride hexahydrate (AlCl3.6H2O), the mixture was incubated at 23.0 °C for a period of 5 min. 1.00 mL of 1.0 M sodium hydroxide (NaOH) was added to the mixture. A blank was prepared by mixing the same reagents without any antioxidant extracts. Sample solutions and standards were homogenized, then absorbances were measured at 356 nm using a UV-VIS Spectrophotometer (UV-2510TS−Labomed).

2.4. DPPH scavenging activity

DPPH radical was used to assess the scavenging activity of total polyphenols present in natural antioxidants as well as vitamin C. The test performed using the protocol described in Ref. [5].

In summary, in 5 test tubes containing 2.50 mL of methanolic extract of natural antioxidant (stock solution 150 mg/100 mL), 2.00 mL of 0.50 mM of 2,2-diphenyl-1-picrylhydrazyl (DPPH) freshly prepared in methanol were added. The mixtures were incubated at 23.0 °C for a period of 30 minutes to allow reactions to take place. The UV–Vis absorbances were measured at a wavenumber of 517 nm using a UV-VIS Spectrophotometer (UV-2510TS−Labomed). Methanol was used as a blank. Absorbances of stock solutions represent the control absorbance (Abefore) of the test and Aafter is the test’s absorbance.

| Table 4 | DSC thermograms summary for frozen Ehrenberg’s snapper with and without antioxidants at −25 °C. |
| Sample | Tm (°C) myosin peak | ΔH°U (J/g) myosin peak | Tm (°C) actin peak | ΔH°U (J/g) actin peak |
|--------|----------------------|------------------------|-------------------|----------------------|
| Reference | 46.87 | 5.949 | 108.59 | 200.9 |
| Frozen Turmeric sample | 75.51 | 73.69 | 111.97 | 482.8 |
| Frozen garlic sample | 48.45 | 7.168 | 110.32 | 431.2 |
| Frozen cinnamon sample | 41.44 | 769.3 | 105.79 | 239.0 |
| Frozen cumin sample | 28.17 | 91.24 | 111.37 | 248 |
| Frozen ginger sample | No peak | No peak | 102.01 | 1367 |
| Frozen Vitamin C sample | 48.30 | 28.65 | 107.61 | 340.5 |
2.5. Lipid extraction

In the thimble of soxhlet apparatus mounted on a around bottle flask containing 90.0 mL of petroleum ether on the top of a heating mantle, 10.0 g of Ehrenberg’s snapper’s freshly prepared mince fillets. The mince fillets were extracted in the apparatus for a period of 3 hours, then, the extraction solvent was evaporated in the rotary evaporator. The mass of oil obtained was measured on analytical balance.

2.6. Peroxide value (PV)

Primary oxidation of Ehrenberg snapper’s oil and the measurement of hydroperoxides were determined by peroxide value analysis, that consist of measuring the amount of iodine formed by the reaction of peroxides formed in fat or oil with iodide ion. The test was performed using protocol described by Ref. [6]. In 250 mL conical flask containing 10.0 mL of chloroform (CHCl₃), 15.0 mL of glacial acetic acid (CH₃COOH) and 1.00 mL of freshly prepared potassium iodide (KI), 0.18 g of fish oil extracted by soxhlet apparatus. The conical flask was tightly closed and gently swirled to allow its contents to mix for 1 min and kept for another 1 min in the dark. 1.00 mL of starch solution (2.00% m/v) and 75.0 mL distilled water were added to the mixture. The solution was titrated with 0.01 M sodium thiosulfate (Na₂S₂O₃). The indicator was added towards the end of the titration while the pale straw colour is still present. The solution was shaken during titration until the blue colour disappeared. A blank titration was carried out under the same conditions on a mixture containing all reagents used in the test except the oil. No more than 0.50 mL of 0.01 M sodium thiosulfate solution should be consumed for this purpose.

2.7. Proteins content

Proteins content measurement was carried based on the concept that the amino acids building blocks of protein when digested will be converted to ammonia. The test was carried out using the Kjeldahl procedure described in Ref. [7]. 1.00 g of the minced fillets was digested in 20 mL of (H₂SO₄, 96%) together with two selenium catalyst tablets (5.0 g K₂SO₄; 0.15 g CuSO₄.5H₂O; 0.15 g TiO₂). The mixture was boiled in a distillation apparatus for 2 hours. The digestion of the minced fillets continued until a clear solution was developed. Then the flask was left to cool down for 15 minutes. This technique is based on the conversion of nitrogen present in proteins to ammonia in the form of ammonium sulphate. 20.0 mL of 0.50 M sodium hydroxide (NaOH) was added to allow the release of ammonia via steam distillation in the distillation apparatus, and the distillate was collected over 25.0 mL of boric acid (4.00% m/v) then titrated against a standard solution of 0.05 M sodium carbonates (Na₂CO₃) using methyl orange as indicator.

2.8. Moisture content

5.00 g of fresh fish tissue were placed in three pre-weight glass watch, then heated in an oven preset in 100 °C. The glass watch were kept in the oven for a period of 24 hours, then taken and cooled in a desiccator. The moisture content was determined form the mass difference between empty and desiccator dried glass watch.

2.9. Ash content and X-ray fluorescence (XRF) analysis

6.00 g of fresh fish tissue were placed in three pre-weight silica dishes. The dishes were heated on a hot plate under the fume hood for a period of 10 min until moisture was removed completely, then they were placed in a programmed muffle furnace set at final temperature of 550 °C with a speed of 10 °C/min, the samples were kept at this final for a period of seven hours. Ash obtained in the silica dishes were taken measured and taken to XRF analysis to determine the fish composition in metals to look for any toxic heavy metals. The XRF machine was (XGT-7200 X-ray Analytical Microscope – Horiba).
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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.104927.

References

[1] A. Elgamouz, R. Alsaidi, A. Alsaidi, M. Zahri, A. Almehdi, K. Bajou, The effects of storage on quality and nutritional values of Ehrenberg’s snapper muscles (Lutjanus Ehrenbergi): evaluation of natural antioxidants effect on the denaturation of proteins, Biomolecules 9 (2019) 442, https://doi.org/10.3390/biom9090442.
[2] Burning issue: a fishy tale, Available online: https://www.caterermiddleeast.com/18627-burning-issue-a-fishy-tale. (Accessed 25 December 2018).
[3] V.L. Singleton, J.A. Rossi, Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents, Am. J. Enol. Vitic. 16 (1965) 144–158.
[4] H. Park, S. Lee, H. Son, S. Park, M. Kim, E. Choi, T.S. Singh, J. Ha, M. Lee, J. Kim, Flavonoids inhibit histamine release and expression of proinflammatory cytokines in mast cells, Arch Pharm Res 31 (2008) 1303.
[5] W. Brand-Williams, M. Cuvelier, C. Berset, Use of a free radical method to evaluate antioxidant activity, LWT-Food Sci. Technol. 28 (1995) 25–30.
[6] AOCS method D Firestone (Ed.), Official Methods and Recommendation Practices of the American Oil Chemists’ Society, 1989.
[7] AOAC Methods Official Methods of Analysis of AOAC International, AOAC Intl.pv, Arlington, Va, 1995 (loose-leaf).