ISSN: 2572-3278

Kamel et al. J Nutri Med Diet Care 2022, 8:056
DOI: 10.23937/2572-3278/1510056
Volume 8 | Issue 1
Open Access

Journal of
Nutritional Medicine and Diet Care

ORIGINAL ARTICLE

Evaluation of Vitamin D3 Content in Selected Dried, Canned and Smoked Fish

Sahar M Kamel[1,2*], *Hajer A Alboudrees*[1] and *Hala H Alotaibi*[1]

[1]*Department of Food and Nutrition Sciences, College of Agriculture and Food Science, King Faisal University, Saudi Arabia*

[2]*Department of Special Food and Nutrition, Food Technology Research Institute, Egypt*

***Corresponding author:** *Sahar M Kamel, Department of Food and Nutrition Sciences, College of Agriculture and Food Science, King Faisal University, Saudi Arabia*

Abstract

The aim of the current study was to shed light on vitamin D3 content in some fishery products that may help the consumers to meet their requirement of vitamin D. The selected products included dried shrimp and fish (sardines and mackerel), canned tuna, sardines, salmon, anchovies and smoked salmon and herring. Vitamin D3, moisture, fat content, antioxidant activity and pH values were estimated for these products, and the percent daily value of vitamin D was calculated. The results revealed that dried sardine showed the highest vitamin D content (48.86 µg/100g), followed by canned anchovy (15.22 µg/100g), then Smoked herring (12.12 µg/100 g). The lowest content of vitamin D was found in white tuna meat canned in water (6.81 µg/100g) and pink salmon in water (3.58 µg/100g). The percent daily value of vitamin D in the selected fishery products extended between 325.73% for dried sardine and 33.87% for salmon canned in water per serving. In conclusion, the daily requirement of vitamin D could be covered by consuming 30.70g of dried sardine, 98.55g of canned anchovy or 123.76g of herrings. The present results may assist the consumers to get their daily value of vitamin D3 from some natural sources. However, studies are needed to renew the use of dried fish or shrimp in future dishes as a high source of vitamin D.

Keywords

Vitamin D, Fish, Daily value, Processed fish

Introduction

Vitamin D deficiency is still a major public health problem worldwide in all age groups, even in countries with low latitude, where the UV radiation was enough to prevent this deficiency, and in industrialized countries, where vitamin D fortification has been implemented [1]. The dietary intakes of vitamin D have been estimated to be low ranged between 3 to 7 µg/day, depending on diet, age, sex and fortification practices [2]. Fish are considered as nutritionally valuable part of the human diet, mostly due to the content of long chain polyunsaturated n-3 fatty acids. Furthermore, fish is also an excellent source of vitamin D3 especially oily fish including salmon and mackerel [3,4]. In animal products including fish, vitamin D3 is found together with its metabolite 25(OH)-D3. This metabolite is biologically active and its bioactivity is higher than vitamin D3 [5]. Cholecalciferol (D3) intervention was more efficacious than ergocalciferol (D2) in improving serum levels of total 25(OH)D and 25(OH)D3 irrespective of the participant demographics, dosage and vehicle of supplementation [6]. Vitamin D3 content of some fish products ranged between about 2 and 196 µg/kg. Large variations were found between different fish species and also between the same species from different locations. The variations in vitamin D content between the same species of fish looked not correlated to the weight, age, or sex of fish but depends on the vitamin d content in fish food and feed. Contrary to general belief, no significant correlation between vitamin D and fat content was reported [7]. Generally, fish processing methods, high and low temperature treatments, could be including, chilling, freezing, canning, smoking, drying, salting, frying and fermenting, sun-drying, grilling and frying, and various combinations of these, to give the fish product a form which is attractive to consumers and prolong storage life [8]. Dried fish from low-cost

Citation: Kamel SM, Alboudrees HA, Alotaibi HH (2022) Evaluation of Vitamin D3 Content in Selected Dried, Canned and Smoked Fish. J Nutri Med Diet Care 8:056. doi.org/10.23937/2572-3278/1510056

Accepted: January 20, 2022: **Published:** January 22, 2022

Table 1: List of selected processed fish products collected from local markets.

Dried fish	Canned/water	Canned fish/oil	Smoked fish
Sardine	Sardine/tomato paste	Anchovy	Herrings
Mackerel	Salmon	Sardine/soy oil	Pink salmon
Shrimp	White tuna	Tuna/sunflower oil Tuna/olive oil Mackerel	Norwegian salmon

traditional industries and citizens exercised on the Blue Nile and White Niles. Completely dried-shrimp or powdered-shrimps have been widely accepted, as they can be used as spices in soups or foods for flavor and protein source [9,10]. The lack of studies about vitamin D content in the processed fish may play a role in decreasing the intake of vitamin D. Therefore, the aim of this study was to determine the vitamin D content of certain fishery products and explain the percent daily value for each product in order to assist consumers in obtaining their requirement of vitamin D through an array of choices.

Materials and Methods

Fourteen processed fish products were purchased from local markets in Al-Ahsa, Saudi Arabia. Table 1 shows the purchased samples, which included dried, smoked, and canned fish.

Chemical analysis

Moisture and fat content were determined using standard protocol [11]. The data were expressed on the wet and dry weight basis.

The pH measurement

After homogenizing one gram of sample with 10 ml of distilled water, the pH was measured at 17 °C using a digital pH meter (Model 320, Mettler-Toledo Ltd., Essex, UK).

Antioxidant activity (AA)

The free radical scavenging capacity of sample extract against DPPH (1,1-diphenyl-2 picryl hydrazyl) was estimated [12]. One milliliter of extract was mixed with one milliliter of a 0.4 mmol in methanolic solution containing DPPH. The mixture was left in the dark for 30 minutes before the absorbance at 516 nm was measured (UV-VIS spectrophotometer, Apel, Japan).

Determination of vitamin D3

Vitamin D as Cholecalciferol was determined according to the method described by [13].

Preparation of Samples**:** Weight equivalent to 40,00000 IU vitamin D3 of samples were dissolved in 25 ml of solution mixture (chloroform and methanol in a 1:9 ratio). At 264 nm, its absorbance was measured.

Preparation of vitamin D3 (cholecalciferol): Accurately 25 mg vitamin D3 working standard was dissolved in 25 ml of solution mixture (chloroform and methanol in a 1:9 ratio). The absorbance was recorded at 264 nm.

Vitamin D (µg/100g) = (Sample Absorbance/ standard Absorbance)*(Standard Weight/sample weight)*(Standard Dilution/Sample Dilution)*Standard potency*Average Weight

Calculation of percent daily value of vitamin D

The potential contribution of fish products to daily value of foods (V%) was calculated using recommended daily allowance of 15 µg/day for all life-stage groups except those aged 71 and up [14]. Hundred grams of samples has been used as serving size of meats to calculate the DV% [15].

Statistical analysis

Gen-Stat Release 7.2 (PC/Window XP) program was used to define the significance of differences between samples at significance levels of $P \leq 0.05$.

Results

Physicochemical properties

Fourteen Fisher products were examined for physicochemical properties (Table 2). The moisture and fat content of the samples varied greatly depending on the process used; the highest moisture content was found in samples canned in water, ranging from 76.91% in salmon to 72.44% in white tuna. Dried samples, on the other hand, had the lowest moisture content (10.19-39.81% in shrimp and mackerel, respectively). Sardine and tuna canned in oil were found to have a high fat content, with values ranging from 14.55% in tuna/olive oil to 19.39% in sardine/soy oil. The low fat content was observed in canned fish filled with water or tomato paste (2.45% in average). The pH ranged from 5.65 in canned anchovy to 7.1 in dried shrimp. Antioxidant activity showed a higher percent in sardine canned in soy oil (90.58%), followed by dried mackerel (82.74%) and dried sardines (81.51%).

Vitamin D content of selected products

The results presented in Table 3 provide details about the vitamin D content of the selected products as well as their contribution to the daily value of vitamin D. Vitamin D content in products ranged from 31.15g/100g

Table 2: Some physicochemical analysis of selected processed fish products.

	Moisture (g/100g)	Fat (g/100g)	pH	AA (%)
Dried samples				
Sardine	12.99 ± 0.13	4.70 ± 0.29	6.4 ± 1.09	81.51 ± 1.34
Mackerel	39.81 ± 0.13	7.02 ± 0.11	6.3 ± 0.00	82.74 ± 0.60
Shrimp	10.19 ± 0.08	5.24 ± 0.06	7.1 ± 1.09	79.74 ± 0.40
Canned samples/water				
Sardine	72.44 ± 0.09	2.75 ± 0.10	5.8 ± 0.0 0	74.90 ± 1.21
Salmon	76.91 ± 5.02	2.11 ± 0.11	6.5 ± 0.00	79.39 ± 1.95
White Tuna	72.48 ± 0.29	2.79 ± 0.00	5.95 ± 0.05	76.57 ± 0.20
Canned samples/oil				
Anchovy	52.45 ± 0.12	9.62 ± 0.13	5.65 ± 0.05	78.60 ± 0.26
Sardine/soy oil	51.69 ± 0.07	19.39 ± 0.09	6.30 ± 0.00	90.58 ± 2.79
Tuna/sunflower oil	58.29 ± 0.06	17.69 ± 0.01	5.95 ± 0.05	72.08 ± 3.29
Tuna/olive oil	59.19 ± 0.07	14.55 ± 0.38	6.10 ± 1.09	77.10 ± 2.61
Mackerel	66.82 ± 0.01	9.68 ± 0.10	6.50 ± 0.00	78.78 ± 0.33
Smoked samples				
Herrings	63.32 ± 0.19	12.09 ± 0.10	5.90 ± 1.09	78.51 ± 4.80
Salmon	65.56 ± 0.30	7.64 ± 0.01	6.40 ± 1.09	73.45 ± 3.55
Pink Salmon	71.37 ± 0.26	4.38 ± 0.19	6.50 ± 0.00	74.50 ± 0.69
LSD	0.26	0.25	0.04	3.58

Table 3: Vitamin D content and DV% of selected processed fish products.

Samples	Vitamin D (µg/100gWB)	Percent daily value (%DV)	The amount to get % DV
Dried samples			
Sardine	48.86 ± 0.01	325.73	30.70
Mackerel	31.15 ± 0.90	207.67	48.15
Shrimp	44.78 ± 2.08	298.00	33.56
Canned samples/water			
Sardine (tomato paste)	6.81 ± 2.36	45.40	220.26
Salmon	5.08 ± 0.26	33.87	295.28
White Tuna	5.20 ± 0.03	34.67	288.46
Canned samples/oil			
Anchovy	15.22 ± 1.15	101.47	98.55
Sardine/soy oil	9.22 ± 0.03	61.47	162.69
Tuna/sunflower oil	8.12 ± 0.24	54.13	184.73
Tuna/olive oil	7.10 ± 0.05	47.33	211.27
Mackerel	5.85 ± 0.29	39.00	256.41
Smoked samples			
Herrings	12.12 ± 0.58	80.80	123.76
Salmon	9.07 ± 0.25	60.47	165.38
Pink Salmon	6.31 ± 0.26	42.07	237.72

in dried mackerel to 48.86g/100g in dried sardine. Which is approximately 325.73 and 207.67% of the recommended dietary allowance of 15 µg, respectively [16]. Anchovies and sardines canned in soy oil (100g) were found to contain 101.47 and 61.47% of the RDA, respectively. Smoked herring and smoked salmon satisfy 80.8 and 60.47% of the RDA, respectively. The vitamin D content of canned tuna in oil was found to be significantly higher than that of canned tuna in water. Sardine canned in oil, rather than dried sardine, is a good source of vitamin D with 9.22 µg/100g and covers 61.47% of the recommended dietary allowance.

Correlations between vitamin D content and some physicochemical properties

The data analysis (Table 4) revealed a positive

Table 4: Correlation between vitamin D and physicochemical characters of selected fish products.

	Vitamin D (µg/100g)	pH	Fat%	Antioxidant activity %	Moisture%
Vitamin D (µg/100g)	1				
pH	0.3534	1			
Fat %	-0.5575	-0.4033	1		
Antioxidant activity%	0.2815	0.29165	0.04734	1	
Moisture %	-0.8441	-0.4389	0.2864	-0.4019	1

correlation between vitamin D content and both pH (R = 0.3534) and antioxidant activity (R = 0.2815), while significant inverse correlations between vitamin D and moisture content (R = -0.8441) as well as fat content (R = -0.5575) were detected.

Discussion

Fish has been recognized as the best natural source of vitamin D3. Some dried, canned and smoked fish products examined for their vitamin D content and other physicochemical properties in this study. Due to the variation in fish type and the process used, the content of moisture, fat, and vitamin D in the samples varied greatly between samples. Owing to the dehydration and concentration of the nutrients, dried samples had the lowest moisture content but the highest fat. Sardine and tuna canned in oil were found to have a high fat content compared to canned fish filled with brine or tomato paste, which may be attributed to the incorporation of vegetable oil during the canning process. These findings of fat content in fish canned in oil was closed to previous findings [17,18], but higher than the results obtained by other [19]. The pH values between samples varied narrowly and were closed to the pH recorded in the earlier study with average of 6.2 [20]. The antioxidant activity of vitamin D and the antioxidants added during processing may be responsible for the significant increase in antioxidant activity in canned samples compared to other samples as stated previously [21]. As shown in the results of vitamin D estimation, dried fish and shrimp are excellent sources of vitamin D in the diet. The high vitamin D content of dried fish and shrimp may be due to the stability of vitamin D in drying conditions such as the presence of oxygen, long time, and low temperature, which are the main factors influencing the nutritional value of fish in addition to the low moisture content [8]. The decrease in vitamin D content of canned products could be attributed to the fact that canned foods are subjected to high thermal treatment during cooking and sterilization [22]. Furthermore, the addition of vegetable oil to canned fish may alter the content of vitamin D in this product and this alteration may depend on the fish type or the vitamin D content of vegetable oil used. Moreover, leaching of nutrients, in particular vitamin D, into cooking liquors is becoming more widely recognized as a major source of nutrient loss [8]. Unpredictably, the inverse correlation between vitamin D content and fat content found in this study may be in arrears to the exchange of fish oil by vegetable oil during the canning process, that resulted in vitamin D dilution or leaching in these products. Moreover, the higher temperature used in canning in oil process (121 °C) rather than other processing such as smoking and drying, may play a significant role in vitamin D alteration in canned products.

The positive relationship between vitamin D content and antioxidant activity could be related to the antioxidant activity of vitamin D itself as suggested by previous study that vitamin D3 has a role in regulation of oxidative metabolism [23,24]. Our findings demonstrated that all selected products in this study are a high source of vitamin D with more than 20% of DV. The percent daily value of vitamin D in the selected fishery products extended between 325.73% in dried samples and 33.87% in salmon canned in water (per serving). Finally, about 30.70g of dried sardine, 98.55g of canned anchovy or 123.76g of herrings could present the daily value of vitamin D. The present study may help in presenting different choices for vitamin D that help the consumers to get their recommended daily allowance of vitamin D.

Conclusion

The findings concluded that the selected fish products, specially the dried ones, could ensure the daily value of vitamin D. More studies are needed to incorporate dried fish and shrimp into new dishes, or as spices in sea food soups, or to revitalize old traditional meals that use dried fish to minimize vitamin D deficiency.

Funding

This work is not financially supported.

Contribution

All of the authors contributed equally to this work, and they all read and approved the published version of the manuscript.

Conflict of Interest

The authors declare that they have no conflicts of interest.

References

1. Palacios C, Gonzalez L (2014) Is vitamin D deficiency a major global public health problem? J Steroid Biochem Mol Biol 144: 138-145.

2. Kiely M, Black LJ (2012) Dietary strategies to maintain adequacy of circulating 25-hydroxyvitamin D concentrations. Scand J Clin Lab Invest 243: 14-23.

3. Khalili Tilami S, Sampels S (2018) Nutritional Value of Fish: Lipids, Proteins, Vitamins, and Minerals. Rev Fish Sci Aquac 26: 243-253.

4. Lu Z, Chen TC, Zhang A, Persons KS, Kohn N, et al. (2007) An evaluation of the vitamin D3 content in fish: Is the vitamin D content adequate to satisfy the dietary requirement for vitamin D? J Steroid Biochem Mol Biol 103: 642-644.

5. Jakobsen J (2007) Bioavailability and bioactivity of vitamin D3 active compounds - Which potency should be used for 25-hydroxyvitamin D3? Int Congr Ser 1297: 133-142.

6. Balachandar R, Pullakhandam R, Kulkarni B, Sachdev HS (2021) Relative efficacy of Vitamin D2 and Vitamin 3 in improving Vitamin D status: Systematic review and meta-Analysis. Nutrients 13: 3328.

7. Mattila P, Piironen V, Uusi-Rauva E, Koivistoinen P (1995) Cholecalciferol and 25-hydroxycholecalciferol contents in fish and fish products. J Food Compos Anal 8: 232-243.

8. Abraha B, Admassu H, Mahmud A, Tsighe N, Shui XW, et al. (2018) Effect of processing methods on nutritional and physico-chemical composition of fish: A review. MOJ Food Process Technol 6: 376-382.

9. Hassan ZMA, Sulieman AME, Elkhalifa EA (2014) Nutritional value of Kejeik: A dry fish product of the Sudan. Pak J Biol Sci 17: 1115-1123.

10. Donsì G, Ferrari G, Di Matteo P (2001) Utilization of combined processes in freeze-drying of shrimps. Food and Bioproducts Processing 79: 152-159.

11. AOAC International (2016) Official methods of analysis of AOAC International. Assoc Off Anal Chem Int 3172.

12. Zhang D, Hamauzu Y (2004) Phenolics, ascorbic acid, carotenoids and antioxidant activity of broccoli and their changes during conventional and microwave cooking. Food Chem 88: 503-509.

13. Rajput GK, Kumar A, Kumar A, Srivastav G (2011) To develop a simple (uv-vis spectrometric) method for the estimation of multivitamin with special reference to Capsules & Tablets. Int J drug Formul Res 2: 43-48.

14. Ross AC, Manson JE, Abrams SA, Aloia JF, Brannon PM, et al. (2011) The 2011 report on dietary reference intakes for calcium and vitamin D from the institute of medicine: What clinicians need to know. J Clin Endocrinol Metab 96: 53-58.

15. Enser M, Hallett K, Hewitt B, Fursey GA, Wood JD (1996) Fatty acid content and composition of English beef, lamb and pork at retail. Meat Sci 42: 443-456.

16. Bresson JL, Burlingame B, Dean T, Fairweather-Tait S, Heinonen M, et al. (2016) Dietary reference values for vitamin D. EFSA J 14.

17. Selmi S, Monser L, Sadok S (2008) The influence of local canning process and storage on pelagic fish from Tunisia: Fatty acid profiles and quality indicators. J Food Process Preserv 32: 443-457.

18. Aakre I, Næss S, Kjellevold M, Markhus MW, Alvheim AR, et al. (2019) New data on nutrient composition in large selection of commercially available seafood products and its impact on micronutrient intake. Food Nutr Res 63: 1-12.

19. Bahurmiz OM, Adzitey F, Ng WK (2017) Nutrient and fatty acid composition of the flesh of oil sardine (Sardinella longiceps) and Indian mackerel (Rastrelliger kanagurta) from Hadhramout coast of the Arabian Sea, Yemen. Int Food Res J 24: 2387-2393.

20. Kayim M, Can E (2010) The pH and total fat values of fish meat in different iced storage period. Asian J Anim Vet Adv 5: 346-348.

21. Mei J, Ma X, Xie J (2019) Review on natural preservatives for extending fish shelf life. Foods 8: 490.

22. Albaali G, Farid MM (2006) Sterilization of food in retort pouches. Steriliz Food Retort Pouches 16.

23. Olubukola Sinbad O, Folorunsho AA, Olabisi OL, Ayoola OA, Temitope EJ (2019) Vitamins as Antioxidants. J Food Sci Nutr Res 2: 214-235.

24. Labudzynskyi DO, Zaitseva OV, Latyshko NV, Gudkova OO, Veliky MM (2015) Vitamin D3 contribution to the regulation of oxidative metabolism in the liver of diabetic mice. Ukr Biochem J 87: 75-90.