Vitamin D in Australian foods – new data for national food composition tables

***Abstract***

**Objective**

There is limited data on the vitamin D content of foods sold in Australia despite recognition that many Australians are vitamin D deficient. This study aimed to develop a preliminary dataset for cholecalciferol and 25-hydroxy cholecalciferol (25-OHD3) for Australia’s food composition database, NUTTAB.

**Design**

Eight purchases of each of 22 animal-based foods were composited and analysed before and after cooking. Vitamin concentrations were measured using normal phase liquid chromatography with ion trap mass spectroscopy, with a limit of reporting of 0.1-0.2 µg/100 g, suitable for the low vitamin D levels expected in unfortified foods.

**Setting**

Samples were purchased from retail outlets in five Australian cities in May 2015.

**Subjects**

Not applicable.

**Results**

Cholecalciferol was found in eggs, fish, chicken leg meat, lean pork and the separable fat of pork, beef, lamb and chicken, but not in chicken breast meat or lean beef rump and lamb. In contrast, 25-OHD3 was found in lean beef and lamb, and in fish, eggs, chicken leg meat and skin/fat, but not in pork, chicken breast or beef, lamb and pork separable fat. No foods contained ergocalciferol or 25-hydroxy ergocalciferol. Effect of cooking on vitamin D levels was inconsistent.

**Conclusions**

Further analysis is needed to confirm these findings and develop more robust estimates of vitamin D concentrations in animal-based foods and cooking stability.

**Keywords:** Vitamin D; cholecalciferol; 25-hydroxy cholecalciferol; ergocalciferol; 25-hydroxy ergocalciferol; NUTTAB; Australia

***Introduction***

There is considerable interest in the role of vitamin D in a range of chronic diseases, including bone fractures(1), cancer(2) and cystic fibrosis(3). In Australia, there is increasing recognition that a considerable proportion of the population has poor vitamin D status, and that this should be addressed through diet and appropriate sunlight exposure. The Australian Health Survey 2011-13(4) studied the vitamin D status of Australians and estimated that 6.5% of Australians over the age of 18 years had serum levels of vitamin D that indicated moderate or severe deficiency (<30 nmol/L) and another 17.0% had serum levels indicating mild deficiency (30-49 nmol/L). Australian health authorities established in 2006 that an Adequate Intake (AI) of vitamin D from the diet for Australian adults 19-50 years is 5 µg/day, rising to 10 µg/day for those aged 51-70 years and 15 µg/day for those over 70 years of age; these intakes assumed no or minimal sunlight exposure(5).

When the updated nutrient reference values for vitamin D were released in 2006, it was noted that accurate estimates of vitamin D intake were not available due to there being limited compositional data in national food composition databases. This report also stated that very few foods contain significant amounts of vitamin D and that fortified margarine appears to be the major dietary source of vitamin D(5). Since that time it has still not been possible to estimate dietary vitamin D intake because the lack of reliable data on levels of vitamin D in Australian foods has remained. Despite this, researchers have suspected that Australian foods do contain nutritionally relevant levels of vitamin D(6).

In part, the lack of data on vitamin D levels in Australian foods has reflected difficulty in analyzing the low levels of vitamin D present in unfortified foods. In past analyses of Australian meats, the limit of reporting for the available method was as high as 5 µg/100 g for cholecalciferol and 25-OHD3(7). At this limit, the method was only appropriate for use in fortified foods such as margarine spreads (6.5 µg cholecalciferol/100 g(8)). In recent years, improved methods of analysis have seen this limit reduced to as low as 0.03 µg/100 g for cholecalciferol in meat, and 0.05 µg/100 g for 25-OHD3(9). This has led to a limited number of analyses of unfortified foods being carried out(6, 11, 12).

The national reference food composition database, NUTTAB(10), is produced by Food Standards Australia New Zealand (FSANZ) and contains nutrient data for 2668 foods, in its current edition. At present, NUTTAB data for vitamin D(8) are held outside the main reference database, which is accessible online. This is because the dataset is small and of questionable quality for most of the unfortified foods. Recent data for fortified margarine spread, cheese, milk, mushrooms, goat meat and chicken eggs have been gathered as opportunities for analysis have arisen, but not yet published in NUTTAB, and there has been no large scale study designed specifically to measure vitamin D levels in unfortified foods in Australia.

Given the interest in data for vitamin D in foods and the availability of the improved method of analysis, FSANZ decided to commission a survey of levels of cholecalciferol, ergocalciferol, 25-hydroxy cholecalciferol (25-OHD3) and 25-hydroxy ergocalciferol in a range of popular animal-based foods sold in Australia. The aim was to generate sufficient data that provisional vitamin D values could be included in the next edition of NUTTAB, planned for release in 2017, for some foods. The study also aimed to identify food groups that contain relatively high levels of vitamin D and could be candidates for more detailed study if and when further funds become available; and to develop some information on possible losses of vitamin D on cooking.

**Methods**

Samples were chosen for analysis based on being commonly consumed by Australians (e.g. beef steak, lamb chops, dairy milk) and/or being typical ingredients in mixed dishes (e.g. eggs, cheese). Only animal foods were selected in this study as it was considered unlikely that any plant-based foods, other than mushrooms, would contain measurable levels of vitamin D. Mushrooms had previously been analysed in early 2015 using the same method of analysis. The analysed content for regular, whole mushrooms was 2.3 µg/100 g ergocalciferol(13) . The total number of samples was constrained by the available budget and the decision to analyse some foods both before and after cooking.

Twenty-two foods were selected in five Australian cities (Canberra, Perth, Adelaide, Brisbane and Melbourne) in May 2015 (20 foods) and August 2015 (2 foods) (see Table 1). Four of the meats (beef steak, lamb chop, pork chop and chicken leg) were divided into separable lean (muscle portion only with no obvious fat remaining) and separable fat (fat tissue with no muscle included) or separable skin and fat combined (chicken leg). Fifteen of the purchased foods were subsequently cooked in the laboratory and vitamin D levels measured in both raw and cooked portions. This yielded a total of 41 analytical samples. Due to difficulties in separating lean and fat in the beef steaks, which are typically sold in Australia trimmed of most selvedge fat, additional samples were purchased specifically for preparation of the separable fat portions; only two purchases of each of two beef cuts were made, rather than eight as for other samples.

Purchase outlets reflected typical buying patterns for that food, which in Australia is largely from supermarkets(14) but also from some independent outlets. For branded products, market leading brands were selected. For each sample, a total of eight purchases were made. Each analytical sample was a composite that comprised equal aliquots from each of these eight purchases. The amount of sample purchased per site reflected the need for sufficient sample for cooking and analysis, the likely effects of cooking loss and removal of inedible portion. Typically, purchase amounts per site ranged from 500 – 1000 g.

Foods that are typically consumed in the cooked state, but purchased in the raw state, were cooked in the laboratory using typical home cooking techniques. Meats and chicken were fried in non-stick frying pans over a moderate heat source, without use of fat, oil or water, until cooked; cooking times varied according to the requirements of the sample. Fish samples were baked in a domestic oven at 180oC for 4-6 minutes per centimeter of thickness. Any liquid remaining in the frying pan or baking tray after cooking was discarded. Samples that are consumed in the ‘as purchased’ state (canned tuna, battered and fried shark, milk and cheese) did not have any further cooking in the laboratory. Eggs were only analysed in the raw state.

Laboratory handling instructions required avoidance of excessive exposure to light and air during cooking and preparation of composite samples due to the labile nature of vitamin D.

All samples were analysed for moisture (AOAC 934.06(15)) and four compounds with vitamin D activity (cholecalciferol, 25-hydroxy cholecalciferol (25-OHD3), ergocalciferol and 25-hydroxy ergocalciferol) by normal phase liquid chromatography with ion trap mass spectroscopy(9) at the National Measurement Institute (Melbourne, Australia), an ISO 9001 certified laboratory. The limit of reporting (LOR) achieved was 0.2 µg/100 g for both cholecalciferol and 25-OHD3, except in milk where a lower limit (0.1 µg/100 g) was able to be achieved. For cholecalciferol and 25-OHD3, acceptable relative percent differences between replicates was stated as being less than 10% but only if the reported value was more than 10 times the LOR, equivalent to 2.0 µg/100 g in these analyses.

True retention (TR) of vitamin D, which represents the effect of cooking on vitamin D levels after changes in moisture content and other cooking losses are taken into account, was calculated as described by Murphy *et al*.(16).

For two of the three fresh fish samples (snapper, hoki) the identity of species purchased was confirmed by DNA analysis (speciation by restriction fragment length polymorphism polymerase chain reaction (RFLP PCR) DNA Amplification) using in-house identification standards. This was not done for salmon as generally only a single salmon species (*Salmo salar*) is sold as such in Australia and is clearly distinguishable from the fish sometimes called Australian salmon. For processed fish, species was not determined as these products contain other protein sources (e.g. egg, dairy) and there is likely to be cross-contamination from traces of other fish species during cooking.

**Results**

Results of all analyses are shown in Table 2.

*Moisture*

Moisture levels measured were comparable to values for the equivalent foods in NUTTAB(10). This suggests that the selection and preparation of the samples was carried out as intended, because if samples had been over-cooked or incorrectly purchased, major differences in moisture content would have been expected.

*Cholecalciferol*

Quantifiable levels of cholecalciferol were found in eggs and in all meat and fish samples except the separable lean portion of beef rump steak and lamb loin chop, and chicken breast meat. Levels were highest in raw and cooked pork loin chop separable fat (5.5 and 6.0 µg/100 g) but much lower in the separable lean from this sample. Similarly, the raw and cooked separable fat from the beef and lamb samples contained higher levels of cholecalciferol (0.7-1.3 µg/100 g) than the separable lean (<0.2–0.3 µg/100 g) although the beef fat samples were not from the same purchased samples. In contrast, among dairy foods only reduced fat milk had a quantifiable amount of cholecalciferol (0.1 µg/100 g). As many of the samples had cholecalciferol concentrations close to the LOR, measurement uncertainty, which represents the range of values that could contain the reported value(17) would be expected to be substantial.

After cooking, cholecalciferol levels stayed approximately the same, or increased, in most samples, when expressed on a fresh matter basis. When expressed as true retention (see Table 3), cholecalciferol retention on cooking varied widely, from 35% in rump steak separable fat to 175% in chicken skin and fat. Overall, true retention of cholecalciferol under dry heat cooking conditions averaged 105%. When true retention was estimated only for the three samples with cholecalciferol levels more than 10 times the LOR of 0.2 µg/100 g, for which replicates would show satisfactory relative percent differences, the average retention of cholecalciferol was 80%.

*25-hydroxy cholecalciferol*

In raw samples, 25-OHD3 was present at quantifiable levels (0.2–1.3 µg/100 g) in eggs, minced beef, the separable lean of beef steaks and lamb chop, and in the flesh and skin/fat from chicken legs. In contrast to the pattern seen for cholecalciferol, in beef and lamb separable fat, 25-OHD3 was not found. Neither the lean nor fat portions of pork chops contained 25-OHD3, nor did the breast meat of chicken. Among the fresh fish samples, raw salmon and snapper also contained 25-OHD3 but raw hoki did not. No quantifiable 25-OHD3 was found in the fish samples that were purchased pre-cooked/canned, nor in any of the dairy samples.

After cooking, 25-OHD3 levels stayed approximately the same or declined slightly in most samples, but increased in chicken leg meat, salmon and snapper. True retention ranged from 35-145% and averaged 80%, somewhat lower than for cholecalciferol (see Table 3). As for cholecalciferol, measured levels in many samples were close to the LOR of 0.2 µg/100 g and would be associated with substantial measurement uncertainty. For the two fish samples where both raw and cooked 25-OHD3 concentrations were more than 10 times the LOR, true retention averaged 120%.

*Ergocalciferol and 25-hydroxy ergocalciferol*

Neither ergocalciferol nor 25-hydroxy ergocalciferol were detected in any samples.

*Quality control results*

Relative percent difference in moisture content between replicates of 15 samples averaged 0.3% (0-0.8%), indicating satisfactory sample homogeneity was achieved. Control foods analysed for moisture (FAPAS pasta and cheese bake from FAPAS proficiency report 25127, in-house apricot jam) were within specification for moisture analysis. For cholecalciferol, an in-house control food (infant formula, assigned value 6.68 µg/100 g) averaged 97.5% recovery and relative percent differences between replicates was 5%. Two samples were analysed as replicates but cholecalciferol and 25-OHD3 were only quantifiable in one of these (raw beef mince: cholecalciferol 0.2 and 0.3 µg/100 g; 40% relative percent difference; 25-OHD3: 0.5 and 0.6 µg/100 g; 18% relative percent difference). Recovery of spiked cholecalciferol and 25-OHD3 in this sample was 97% and 101% respectively. The high relative percent differences between replicates for cholecalciferol and 25-OHD3 reflect the low reported concentrations, which were only one to three times the LOR.

***Discussion***

The findings of this study are supported by the limited amount of data published recently for Australian foods. For example Liu *et al*.(6, 11) reported quantifiable levels of cholecalciferol and 25-OHD3 in lean beef, lamb, chicken and pork. In this study we found no, or very low, levels of cholecalciferol in raw beef and lamb (<0.2-0.3 µg/100 g) but measurable levels of 25-OHD3 (0.2-0.6 µg/100 g). This is similar to a larger scale study of beef and lamb by Liu *et al*.(11), in which 25-OHD3 was found to be present at approximately twice the concentration of cholecalciferol in the lean portion of Australian beef and lamb. However 20-OHD3 levels in this study were higher than reported by Liu *et al*. (beef: 0.3 µg/100 g, lamb: 0.2 µg/100 g).

In contrast to the finding of 25-OHD3 in lean ruminant meat (beef, lamb) in this study, we found no quantifiable levels of 25-OHD3 in the separable lean of pork and no quantifiable cholecalciferol or 25-OHD3 in the breast meat of chickens, but did find both forms in raw chicken leg meat and in chicken skin and fat. The different concentrations of cholecalciferol in pork and chicken compared to beef and lamb may reflect the use of fortified feeds for pigs and poultry, which in Australia are typically intensively farmed using prepared feeds, compared to beef and lamb which are largely free-ranging for most of their lives and feed predominantly on grass(6). However, the levels of both cholecalciferol and 25-OHD3 in lean pork are markedly higher than reported by Liu *et al.* (0.2 and 1.0 µg/100 g respectively) (6). This suggests that there may be substantial variation in vitamin D levels in animal-based foods and therefore that broad-based sampling plans are important features of food analysis surveys for vitamin D to obtain a representative value.

The estimates of true retention of cholecalciferol and 25-OHD3 varied widely between samples and no clear trends are discernable. While this study was not specifically designed to evaluate stability, overall the results suggests that both forms of vitamin D may be fairly stable under the cooking methods studied, which all involved dry heat without adding any fat, oil or liquid. Jakobsen & Knuthsen(18) examined the stability of these vitamin D compounds in several foods, although not those cooked in this study, and found retention varying from 39-89%. Further research on the area of stability of naturally occurring vitamin D is important for the development of future food composition datasets that cover cooked foods as well as raw.

Although from a limited number of foods, the findings of this study show that, contrary to previous belief that fish was the only unfortified food likely to contain substantial amounts of vitamin D(5), some other Australian animal-based foods do contain nutritionally relevant amounts of vitamin D. Meats and eggs in particular may be important sources of vitamin D, given their relatively high levels of 25-hydroxy cholecalciferol, which is regarded as being five times more bioavailable than cholecalciferol(5). For example, a 125 g serve of cooked beef mince would deliver 3.6 µg total vitamin D, representing 75% of the AI for younger adults, and 25% of that for the over 70 years group, a group known to be at risk for inadequate vitamin D status and poor bone health(5). Likewise, a meal of two eggs would deliver around 100% of the AI for younger adults and 40% of that for those over 70 years, assuming 100% and 80% retention of cholecalciferol and 25-OHD3 respectively after cooking. These findings are important because meat, in particular, is consumed in greater amounts in the Australian diet than is fish(19).

It must be borne in mind that these results cover only a limited number of foods, collected at a single point in time and the majority of values reported were at levels close to the LOR achieved, increasing uncertainty in the reported values. Given the limited data available for comparison, it would be beneficial to generate more data for vitamin D in Australian foods, including multi-ingredient foods, in order to gain a better understanding of the range of concentrations found and to generate more robust estimates of vitamin D levels for use in food composition tables and in estimates of dietary intake. As the levels of vitamin D compounds found in most of the foods studied in this survey were low in relation to the LOR achieved, with a consequent high relative percent difference between replicates, future studies should aim to analyse all samples as replicates, in order to give greater certainty to the reported values. Future refinements to the method of analysis to lower detection and quantification limits would also be beneficial.

***Conclusion***

This study has provided some data that can be used as a foundation for developing a complete vitamin D dataset for the Australian food composition tables. However, given the limited number of samples involved, it is important that the dataset is expanded to cover a wider range of foods and to get more detailed and robust data on meats, fish and eggs, given the nutritionally relevant levels of vitamin D found in these foods. Future studies should also aim to generate further data on vitamin D retention in foods under a range of cooking conditions.

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**Table 1.** Food samples selected for analysis for vitamin D.

|  |  |
| --- | --- |
| **Food and cooking method\* if applicable** | **Sample description** |
| Beef, mince, regular fat, raw & pan fried | Purchased fresh & pre-minced, described as regular, premium or topside mince. |
| Beef, separable lean (rump steak), raw & pan fried | Muscle portion of boneless steaks. Fresh. |
| Beef, separable lean (blade steak), raw & pan fried | Muscle portion of boneless steaks. Fresh. |
| Beef, separable fat (rump steak), raw & pan fried | Visible fat tissue from boneless steaks. Fresh. |
| Beef, separable fat (porterhouse steak), raw & pan fried | Visible fat tissue from boneless steaks. Fresh. |
| Lamb, separable lean (loin chop), raw & pan fried | Muscle portion of lamb chops purchased with bone in place. Fresh. |
| Lamb, separable fat (loin chop), raw & pan fried | Visible fat tissue from lamb chops. Fresh. |
| Pork, separable lean (loin chop), raw & pan fried | Muscle portion of chops purchased with bone in place. Fresh. |
| Pork, separable fat (loin chop), raw & pan fried | Visible fat tissue from pork chops. Fresh. |
| Chicken, skinless breast meat, raw & pan fried | Light coloured meat, sold without bones & skin. Fresh. |
| Chicken, flesh, leg & thigh, raw & pan fried | Darker coloured chicken meat from leg & thigh. Bones, skin and fat removed. Fresh. |
| Chicken, separable fat & skin, raw & pan fried | Skin and visible fat tissue from chicken leg & thigh. Fresh. |
| Egg, chicken, whole, raw only | Free range & cage, large & extra large size. |
| Salmon, skinless, raw & baked | Farmed *Salmo salar*, fresh or frozen at purchase. |
| Snapper, skinless, raw & baked | *Pagrus auratus* (Australasian snapper), *Lutjanus malabaricus* (saddletail snapper) & *Pristipomoides multidens* (gold band snapper), fresh or frozen. |
| Hoki, skinless, raw & baked | *Macruronus novaezelandiae*, fresh or frozen at purchase. |
| Hoki, crumbed or battered, baked only | Skinless hoki pieces coated with batter or crumbs, sold frozen. |
| Shark, crumbed or battered, deep fried, as purchased | Skinless shark flesh, coated in batter or crumbs, deep-fried. Species not identified. |
| Tuna, canned in water, drained | Chunks/flakes of tuna meat, drained before analysis. Species not identified. |
| Milk, cow, regular fat | Homogenised & pasteurised or ultra-heat treated. |
| Milk, cow, reduced fat | Approx. 50% fat reduction, homogenised, pasteurised or ultra-heat treated. |
| Cream, regular fat, thickened | Dairy cream, pasteurised, thickener added. |
| Cheese, cheddar, regular fat | Supplied in pieces or pre-sliced. |
| Cheese, cheddar, reduced fat | Approx. 33% fat reduction. Whole pieces, pre-sliced or pre-shredded. Excludes processed cheddar. |
| Cheese, parmesan | Whole pieces, pre-grated or shaved. Includes Grana Padano. |
| Cheese, brie or camembert | White mould, soft cheese. |

\*No fat or oil added in cooking

**Table 2**. Cholecalciferol, 25-hydroxy cholecalciferol (25-OHD3) and moisture content of raw\* and/or cooked meat, chicken, fish, dairy foods and eggs. All values are per 100 g edible portion.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Food** | **Moisture**  **g/100 g** | | **Cholecalciferol**  **µg/100 g** | | **25-OHD3**  **µg/100 g** | |
|  | Raw | Cooked | Raw | Cooked | Raw | Cooked |
| ***Mammalian meats:*** |  |  |  |  |  |  |
| Beef, mince, regular fat | 69.5 | 65.6 | 0.2 | 0.4 | 0.6 | 0.5 |
| Beef, separable lean (rump steak) | 72.9 | 67.9 | <0.2 | <0.2 | 0.7 | 0.3 |
| Beef, separable lean (blade steak) | 74.5 | 61.6 | 0.3 | 0.7 | 0.2 | <0.2 |
| Beef, separable fat (rump steak) | 28.3 | 17.7 | 1.3 | 0.5 | <0.2 | <0.2 |
| Beef, separable fat (porterhouse steak) | 30.8 | 32.8 | 0.7 | 0.6 | <0.2 | <0.2 |
| Lamb, separable lean (loin chop) | 71.7 | 61.6 | <0.2 | <0.2 | 0.6 | 0.3 |
| Lamb, separable fat (loin chop) | 23.9 | 16.8 | 0.7 | 1.6 | <0.2 | <0.2 |
| Pork, separable lean (loin chop) | 73.4 | 63.1 | 0.4 | 0.4 | <0.2 | <0.2 |
| Pork, separable fat (loin chop) | 42.0 | 35.4 | 5.5 | 6.0 | <0.2 | <0.2 |
| ***Chicken meat & eggs:*** |  |  |  |  |  |  |
| Chicken, flesh, breast, skinless | 74.5 | 68.1 | <0.2 | <0.2 | <0.2 | <0.2 |
| Chicken, flesh, leg and thigh, skinless | 75.1 | 68.1 | 0.3 | <0.2 | 1.3 | 2.3 |
| Chicken, separable fat and skin | 45.4 | 43.8 | 0.9 | 2.6 | 1.0 | 1.0 |
| Egg, chicken, whole, raw | 76.6 | - | 1.7 | - | 1.1 | - |
| ***Fish and fish products:*** |  |  |  |  |  |  |
| Salmon, skinless | 66.6 | 67.1 | 3.3 | 3.3 | 0.7 | 1.1 |
| Snapper, skinless | 78.1 | 77.2 | 2.9 | 2.5 | 0.5 | 0.6 |
| Hoki, skinless | 79.9 | 77.5 | 0.8 | 0.6 | <0.2 | <0.2 |
| Hoki, crumbed or battered, frozen | - | 53.8 | - | 0.2 | - | <0.2 |
| Shark, skinless, battered, deep fried | - | 53.0 | - | 0.3 | - | <0.2 |
| Tuna, canned, drained | - | 75.8 | - | 3.3 | - | <0.2 |
| ***Dairy products:*** |  |  |  |  |  |  |
| Milk, cow, regular fat | 87.6 | - | <0.1 | - | <0.1 | - |
| Milk, cow, reduced fat | 89.9 | - | 0.1 | - | <0.1 | - |
| Cream, regular fat | 58.4 | - | <0.2 | - | <0.2 | - |
| Cheese, cheddar, regular fat | 35.4 | - | <0.2 | - | <0.2 | - |
| Cheese, cheddar, reduced fat | 39.7 | - | <0.2 | - | <0.2 | - |
| Cheese, parmesan | 32.5 | - | <0.2 | - | <0.2 | - |
| Cheese, brie or camembert | 50.0 | - | <0.2 | - | <0.2 | - |

\* For dairy products, values under ‘raw’ refer to foods as purchased, with no subsequent cooking

**Table 3.** True retention factors for cholecalciferol, and 25-hydroxy cholecalciferol (25-OHD3) as a result of cooking meat, chicken and fish with dry heat.

|  |  |  |
| --- | --- | --- |
| **Food** | **True retention\*** | |
|  | **Cholecalciferol** | **25-OHD3** |
| *Dry fried meat samples:* |  |  |
| Beef, mince, regular fat | 175 | 75 |
| Beef, separable lean (rump steak) | - | 35 |
| Beef, separable lean (blade steak) | 190 | - |
| Beef, rump steak, separable fat | 35 | - |
| Beef, porterhouse steak, separable fat | 65 | - |
| Lamb, separable lean (loin chop) | - | 35 |
| Lamb, loin chop, separable fat | 155 | - |
| Pork, loin chop, separable lean | 70 | - |
| Pork, loin chop, separable fat† | 90 | - |
| *Dry fried chicken samples:* |  |  |
| Chicken, flesh, leg and thigh, skinless | - | 135 |
| Chicken, separable fat and skin | 145 | 35 |
| *Baked fish samples:* |  |  |
| Salmon, skinless† | 95 | 145 |
| Snapper, skinless† | 75 | 100 |
| Hoki, skinless | 65 | - |
| Mean, dry heat cooking, all samples | 105 | 80 |
| Mean, dry heat cooking, samples  > 2.0 µg/100 g) | 80 | 120 |

\* Rounded to nearest 5%; only estimated for samples with quantifiable results when raw and cooked

† Samples where reported values were > 2.0 µg/100 g, equivalent to 10 times Limit of Reporting (LOR) of 0.2 µg/100 g