# On Japanese Foods,

Report 4.

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## III. Cereals other than Rice and Soybean.

Some cereals taken as food by Japanese were dietetically examined and the biological value of their protein contents, determined by Yamamoto[50] according to Barnes and confirmed in part by Hayashi[25], is shown in Table 43. The amino acid composition of the protein isolated from each of those cereals, from potatoes and from gingko seeds was determined respectively by Kimura[34], Ono[51] and Nagase[49] with the result shown in Table 44. Gingko seeds, though eaten very rarely by Japanese, are unique as a foodstuff in that they are eaten exclussively in East Asia, and our analytical data on their amino acid composition may be of some biological interest.

Table. 43. The biological value of some cereal proteins[50].

| Protein from | Comparative nutritive value | | Biological value | | |
|---|---|---|---|---|---|
| | For growth | For maintenance | Biolog. value | Parts participating in growth | Parts participating in maintenance |
| Whole eggs | 100 | 100 | 99 | 77 | 22 |
| Buck-wheat | 47 | 84 | 45 | 46 | 54 |
| Wheat | 36 | 70 | 35 | 35 | 65 |
| Barley | 34 | 68 | 35 | 34 | 66 |
| Corn | 33 | 59 | 29 | 29 | 71 |

## IV. Foods of marine origin

The biological value of certain Japanese foods of marine origin was estimated by Sakata[52] and is given in the following table, Table 45:

Mackerel was examined as an example of the fish eaten abundantly by the Japanese. It was found to have a higher biological value when eaten raw than when taken broiled at 105° or 150°—a fact of no small importance from the dietetic point of view of the Japanese.

## V. The Digestibility and Absorption rate Japanese Foodstuffs other than Rice.

5 or more human subjects were fed on certain Japanese foods most of them for

Table 44. Amino acid composition of protein isolated from some vegetable foods of Japan.

| | Buck-wheat[34] | Barley[34] | Wheat[34] | Gingko seed[51] | | | | White potato[49] | Sweet potato[49] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Globulin | Glutelin | Water sol. globulin | Albumin | | |
| Asp | 10.31 | 4.47 | 4.80 | 12.25 | 12.33 | 12.01 | 12.98 | 11.9 | 13.1 |
| Thr | 5.0 | 3.64 | 3.52 | 4.97 | 5.05 | 6.76 | 7.61 | 5.4 | 4.6 |
| Ser | 4.37 | 8.01 | 6.35 | 4.71 | 4.81 | 3.94 | 7.59 | 6.0 | 5.5 |
| Glu | 15.67 | 26.19 | 31.49 | 19.43 | 18.09 | 15.77 | 14.16 | 12.2 | 11.8 |
| Pro | 4.66 | 11.49 | 11.60 | 4.77 | 4.08 | 4.19 | 3.10 | 4.5 | 4.3 |
| Gly | 6.34 | 4.82 | 4.12 | 5.58 | 5.64 | 5.41 | 5.48 | 4.8 | 2.6 |
| Ala | 7.21 | 4.07 | 3.74 | 7.00 | 6.58 | 5.08 | 6.60 | 5.1 | 6.1 |
| Cys | 1.53 | 1.79 | 1.67 | 0.35 | 0.35 | 2.62 | 1.72 | 1.3 | 1.6 |
| Val | 6.34 | 6.35 | 4.96 | 4.80 | 4.93 | 7.76 | 7.27 | 5.4 | 7.9 |
| Met | 2.08 | 1.58 | 2.10 | 2.36 | 2.63 | 2.83 | 2.08 | 3.4 | 2.5 |
| Ileu | 5.35 | 4.74 | 4.83 | 3.79 | 5.07 | 4.61 | 3.69 | 5.4 | 5.3 |
| Leu | 7.41 | 6.83 | 7.59 | 9.57 | 8.94 | 8.60 | 6.71 | 7.5 | 8.7 |
| Tyr | 4.12 | 3.73 | 4.18 | 2.94 | 3.17 | 4.75 | 5.27 | 4.2 | 3.6 |
| Phe | 4.19 | 4.25 | 5.36 | 3.35 | 3.53 | 3.41 | 5.11 | 7.4 | 6.0 |
| His | 2.97 | 2.66 | 2.57 | 1.51 | 1.52 | 1.79 | 2.44 | 3.7 | 4.2 |
| Lys | 5.72 | 4.05 | 2.93 | 3.10 | 2.96 | 3.94 | 8.93 | 8.3 | 6.5 |
| Arg | 7.86 | 4.58 | 3.93 | 13.93 | 13.76 | 11.83 | 6.20 | 6.6 | 6.4 |
| Try | 1.25 | 1.25 | 0.78 | 10.3 | 1.32 | 1.39 | 0.98 | 2.0 | 1.8 |
| $HN_3$ | 3.53 | 3.90 | 5.55 | 3.05 | 2.97 | 2.49 | 2.97 | 3.4 | 3.9 |
| Total | 104.90 | 107.62 | 110.19 | 108.49 | 107.73 | 108.18 | 110.84 | 108.5 | 106.4 |

Table 45. The biological value of the protein in some kinds of marine products[52].

| | Comparative nutritive value | | Biological value | | |
|---|---|---|---|---|---|
| | For growth | For maintenance | Biolog. value | Parts participating in growth | Parts participating in maintenance |
| Whole egg | 100 | 100 | 99 | 79 | 22 |
| Mackerel (raw) | 52 | 96 | 42 | 52 | 48 |
| 〃 (105°) | 50 | 86 | 34 | 49 | 51 |
| 〃 (150°) | 50 | 85 | 31 | 47 | 53 |
| Herring roe | 56 | 99 | 46 | 51 | 49 |
| Top shell | 52 | 97 | 42 | 43 | 57 |
| Ark shell | 47 | 62 | 37 | 28 | 72 |
| Oyster | 37 | 42 | 29 | 32 | 68 |
| Jelly-fish | 29 | 15 | 19 | 38 | 62 |
| Sea-slug | 27 | 14 | 17 | 24 | 76 |

3 days and a few for 2 days, and their faeces and urine were examined respectively by Nakamura[53], Kimura[54], Onishi[34], Fujii[35], Ichiki[55], Sakata[56], Yamamoto[57] and Nagase[49]. The real absorption rate of the food taken was computed using either

Table 46. The Absorption rate of Japanese foodstuffs other than rice (%, M±6)

| Food | Crude protein | | Crude fat | | Crude solub. carbohydrate | | Crude fibre | |
|---|---|---|---|---|---|---|---|---|
| | Content | Abspt. rate | Content | Abspt. rate | Content | Abspt. rate | Content | Excretion rate |
| Barley (boiled as grain) | 9.77 | 72.80 ± 1.92 | 1.60 | 57.63 ± 1.17 | 71.58 | 98.36 ± 1.29 | 1.40 | 53.37 ± 4.80 |
| Barley (pressed) | 9.61 | 81.27 ± 1.35 | 0.99 | 59.01 ± 2.60 | 72.46 | 98.77 ± 0.07 | 1.34 | 38.92 ± 4.31 |
| Sweet potatoe | 1.29 | 48.89 ± 4.64 | 0.11 | 36.82 ± 8.23 | 30.48 | 98.50 ± 0.23 | 1.31 | 90.34 ± 5.14 |
| Mungbean | 22.08 | 74.87 ± 1.03 | 1.68 | 87.66 ± 1.32 | 54.29 | 92.63 ± 0.57 | 3.90 | 58.92 ± 3.96 |
| Mungbean (malt) | 2.61 | 98.08 ± 0.81 | 0.17 | 98.87 ± 1.07 | 1.31 | 94.54 ± 0.85 | 0.60 | 84.72 ± 3.92 |
| Hyacinth bean | 23.70 | 91.82 ± 0.17 | 1.14 | 92.48 ± 0.62 | 56.50 | 94.24 ± 1.76 | 3.84 | 57.78 ± 3.97 |
| Cowpea | 24.13 | 93.38 ± 0.30 | 2.18 | 91.78 ±20.72 | 50.48 | 95.10 ± 2.36 | 4.50 | 55.31 ± 4.23 |
| Peanut | 26.07 | 98.98 ± 0.72 | 48.03 | 92.55 ± 0.59 | 16.65 | 95.49 ± 1.54 | 1.49 | 69.99 ± 4.15 |
| Adzukibean | 21.42 | 90.78 ± 2.07 | 1.29 | 83.91 ± 2.56 | 52.01 | 98.30 ± 0.63 | 4.30 | 53.70 ±10.76 |
| Green peas | 7.11 | 93.40 ± 4.54 | 0.63 | 84.54 ± 2.59 | 18.32 | 97.84 ± 0.36 | 2.32 | 38.57 ± 5.13 |
| Broad bean (fresh) | 9.60 | 90.03 ± 2.07 | 0.71 | 87.03 ± 2.34 | 16.56 | 97.97 ± 0.56 | 2.33 | 68.93 ± 7.06 |
| Glycine hispida | 32.85 | 88.65 ± 0.38 | 17.65 | 76.10 ± 0.81 | 25.98 | 98.10 ± 1.05 | 4.47 | 54.11 ± 4.96 |
| Glycine hispida (natto) | 19.31 | 93.01 ± 0.85 | 11.04 | 83.38 ± 0.38 | 7.68 | 97.49 ± 1.08 | 1.21 | 53.26 ± 5.96 |
| Indian lotus | 3.36 | 93.13 ± 1.59 | 0.88 | 94.42 ± 1.41 | 10.70 | 97.58 ± 1.35 | 0.91 | 51.24 ± 6.91 |
| Edible burdock | 2.77 | 92.04 ± 0.36 | 0.68 | 94.01 ± 0.44 | 23.96 | 99.49 ± 0.91 | 1.94 | 47.24 ± 3.78 |
| Bamboo-shoot | 3.49 | 89.36 ± 3.46 | 0.55 | 86.64 ± 4.01 | 3.55 | 94.97 ± 2.85 | 0.83 | 82.06 ± 5.00 |
| Squash | 1.62 | 85.43 ± 0.64 | 1.12 | 84.67 ± 0.77 | 8.86 | 99.04 ± 0.44 | 1.00 | 30.37 ± 5.07 |
| Carrot | 4.40 | 93.01 ± 0.38 | 0.88 | 89.09 ± 0.84 | 4.57 | 96.09 ± 0.53 | 1.13 | 64.88 ± 4.26 |
| Taro | 2.64 | 94.72 ± 0.94 | 0.35 | 71.51 ± 4.93 | 20.86 | 97.87 ± 0.58 | 0.68 | 55.75 ± 9.87 |

Table 46 (continued)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Spinach | 2.31 | 96.81 ± 1.79 | 0.45 | 64.82 ± 4.16 | 2.45 | 91.28 ± 5.02 | 0.33 | 64.25 ± 9.40 |
| Gingko | 5.46 | 95.96 ± 0.47 | 1.44 | 88.51 ± 1.17 | 30.71 | 99.56 ± 0.14 | 0.63 | 27.19 ± 7.34 |
| Konnyaku | 0.12 | 95.13 ± 0.82 | 0.01 | 49.36 ± 2.39 | 2.02 | 89.51 ± 1.97 | 0.11 | 75.66 ± 9.06 |
| Armilaria Matsutake | 1.62 | 95.52 ± 0.96 | 1.32 | 62.61 ± 3.72 | 5.98 | 93.19 ± 1.31 | 2.33 | 80.42 ± 3.16 |
| Cortinellus Shiitake | 14.31 | 92.18 ± 1.02 | 1.91 | 67.05 ± 2.53 | 61.21 | 94.06 ± 3.43 | 4.48 | 47.70 ±10.68 |
| Herring roe | 22.94 | 97.29 ± 0.36 | 2.52 | 92.82 ± 1.24 | 0.51 | 91.48 ± 1.67 | 0 | 0 |
| Sea-slug | 3.22 | 99.58 ± 0.39 | 0.59 | 95.86 ± 1.10 | 0.93 | 95.22 ± 1.85 | 0 | 0 |
| Jelly-fish | 2.58 | 99.71 | 0.24 | 98.11 | 0 | 0 | 0 | 0 |
| Top-shell | 25.62 | 99.09 ± 0.56 | 0.75 | 95.74 ± 1.74 | 3.93 | 97.15 ± 1.12 | 0 | 0 |
| Ark-shell | 11.44 | 98.63 ± 0.86 | 1.42 | 90.07 ± 2.82 | 1.85 | 90.51 ± 2.76 | 0 | 0 |
| Oyster | 9.44 | 97.87 ± 0.53 | 1.36 | 93.61 ± 1.62 | 3.43 | 96.29 ± 0.29 | 0 | 0 |
| Laminaria (Konbu) | 7.25 | 99.31 ± 0.57 | 1.40 | 93.44 ± 0.80 | 43.64 | 82.87 ± 3.48 | 4.30 | 47.16 ± 3.74 |
| Undaria (Wakame) | 12.10 | 95.02 ± 0.32 | 2.00 | 87.70 ± 1.18 | 41.84 | 92.83 ± 1.88 | 3.50 | 37.69 ± 3.33 |
| Porphyra (Nori) | 33.10 | 96.87 ± 0.82 | 1.30 | 99.09 ± 0.63 | 40.20 | 75.24 ± 3.02 | 0.62 | 25.58 ± 8.18 |
| Bread | 7.02 | 93.12 ± 3.02 | 0.89 | 84.66 ± 2.04 | 55.48 | 99.60 ± 0.09 | 0.27 | 38.03 ± 8.66 |
| Buck-wheat (vermicelli) | 3.42 | 88.30 ± 1.61 | 0.63 | 88.00 ± 3.89 | 28.73 | 99.01 ± 0.26 | 0.41 | 62.33 ±12.82 |
| Milk (dried) | 16.89 | 91.65 ± 1.62 | | | | | | |
| Sea bream (boiled) | 19.47 | 96.43 ± 0.36 | 2.63 | 96.50 ± 1.52 | | | | |

the data of Okuda[10] on metabolic N and fat, and the data of real absorption rate of white rice described in the Report 1. The result reached is given in the following table, Table 46:

## SUMMARY OF REPORT 4

Certain cereal foods were examined and compared as to the biological value of their protein contents, and buck-wheat, barley, wheat and corn were found to vary in declining order of biological value.

Certain marine products taken as food were also examined as to the biological value of their protein contents, and fish taken raw in the form of "sashimi", for which most Japanese have a great liking, was found to be of higher biological value than broiled or boiled fish.

The absorption rate of many Japanese foods was determined on humans.

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