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A RAPID METHOD FOR THE DETERMINATION OF MOISTURE CONTENT IN FISH MEAT

II. RELATION BETWEEN ERROR OF ESTIMATION AND FAT CONTENT

By

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In the previous paper, the senior author and T. Nakano have reported a simple method for the determination of moisture content in fish flesh by measuring the specific gravity of the aqueous solution of methylalcohol used as the dehydration agent of fish meat (1). However, the methylalcohol dehydration method is still erroneous in some instances, specially in measuring the scale of hydrometer at constant temperature and in applying this method to the fatty fish meat.

In the present work, the authors have mainly studied the relation between the error of estimation and fat content of fish flesh with a view to obtain more accuracy of the method.

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Materials and Methods

Materials: The materials used in this experiment are saury and sword fish meat, in which the fat content of the dark flesh of saury and the ventral one of the swordfish are respectively higher than that of the normal meat of the former and the dorsal one of the latter fish.

Methods: The moisture content in fish flesh has been determined by the methylalcohol dehydration method and the oven drying method. The fat content has been estimated by the ether extraction method. The other experimental procedures are the same as previously reported.

Results and Discussion

The results obtained are summarized in Tables 1, 2, 3 and 4.

Table 1. Water and crude fat content in lean meat of saury fish.

| Sample number | Apparent water content (in %) | Standard water content (in %) | Conversion factor | Water content found (in %) | Difference between the standard value and found value (in %) | Crude fat content (in %) |
|---------------|-------------------------------|-------------------------------|-------------------|----------------------------|--|--------------------------|
| 1 | 74.2 | 71.5 | 0.964 | 71.6 | +0.1 | 4.29 |
| 2 | 73.1 | 70.8 | 0.969 | 70.5 | -0.3 | 5.67 |
| 3 | 73.1 | 70.2 | 0.961 | 70.5 | +0.3 | 4.21 |
| 4 | 74.0 | 72.8 | 0.984 | 71.4 | -1.4 | 2.38 |
| 5 | 69.8 | 69.8 | 0.999 | 67.4 | -2.4 | 7.69 |
| 6 | 77.9 | 72.7 | 0.933 | 75.1 | +2.4 | 5.85 |
| 7 | 73.6 | 70.4 | 0.956 | 71.0 | +0.6 | 3.23 |
| 8 | 69.6 | 69.2 | 0.995 | 67.2 | -2.0 | 3.12 |
| 9 | 73.7 | 72.4 | 0.983 | 71.1 | -1.3 | 1.87 |
| 10 | 73.0 | 70.5 | 0.966 | 70.4 | -0.1 | 2.66 |
| 11 | 69.9 | 70.3 | 1.006 | 67.5 | -2.8 | 4.22 |
| 12 | 75.5 | 71.8 | 0.952 | 72.8 | +1.0 | 1.33 |
| 13 | 77.4 | 72.9 | 0.942 | 74.7 | +1.8 | 2.14 |
| 14 | 76.1 | 70.9 | 0.931 | 73.5 | +2.6 | 3.38 |
| 15 | 78.1 | 72.3 | 0.926 | 75.4 | +3.1 | 1.95 |
| 16 | 75.9 | 75.0 | 0.988 | 73.2 | -1.8 | 1.76 |
| 17 | 77.4 | 72.6 | 0.937 | 74.7 | +2.1 | 3.14 |
| 18 | 74.7 | 72.9 | 0.976 | 72.1 | -0.8 | 2.39 |
| 19 | 79.8 | 76.2 | 0.955 | 77.0 | +0.8 | 0.70 |
| 20 | 75.6 | 74.0 | 0.978 | 73.0 | -1.0 | 1.52 |
| mean | | | 0.965 | | ±1.4 | 3.18 |

Table 2. Water and crude fat content in fatty dark meat of saury fish.

| Sample number | Apparent water content (in %) | Standard water content (in %) | Conversion factor | Water content found (in %) | Difference between the standard value and found value (in %) | Crude fat content (in %) |
|---------------|-------------------------------|-------------------------------|-------------------|----------------------------|--|--------------------------|
| 1 | 63.5 | 60.5 | 0.952 | 62.9 | +2.4 | 17.41 |
| 2 | 62.3 | 55.5 | 0.890 | 61.7 | +6.2 | 20.87 |
| 3 | 62.2 | 59.8 | 0.962 | 61.6 | +1.8 | 20.29 |
| 4 | 61.8 | 62.6 | 1.013 | 61.1 | -1.5 | 16.44 |
| 5 | 58.5 | 61.0 | 1.042 | 57.9 | -3.1 | 23.65 |
| 6 | 61.4 | 59.7 | 0.973 | 60.7 | +1.0 | 21.11 |
| 7 | 64.3 | 63.6 | 0.990 | 63.6 | ±0.0 | 14.34 |
| 8 | 55.8 | 60.2 | 1.078 | 55.2 | -5.0 | 18.29 |
| 9 | 58.7 | 60.9 | 1.038 | 58.1 | -2.8 | 17.23 |
| 10 | 65.1 | 65.5 | 1.007 | 64.4 | -1.1 | 11.58 |
| 11 | 58.4 | 58.2 | 0.998 | 57.8 | -0.4 | 17.64 |
| 12 | 65.3 | 64.9 | 0.994 | 64.6 | -0.3 | 11.99 |
| 13 | 67.7 | 63.9 | 0.943 | 67.0 | +3.1 | 13.20 |
| 14 | 65.0 | 63.7 | 0.980 | 64.4 | +0.7 | 13.85 |
| 15 | 68.6 | 66.1 | 0.964 | 67.8 | +1.8 | 10.21 |
| 16 | 68.8 | 68.0 | 0.988 | 68.1 | +0.1 | 9.46 |
| 17 | 63.9 | 65.4 | 1.023 | 63.3 | -2.1 | 11.29 |
| 18 | 67.5 | 64.4 | 0.954 | 66.8 | +2.4 | 13.24 |
| 19 | 74.1 | 74.7 | 1.009 | 73.3 | -1.4 | 9.36 |
| 20 | 68.5 | 68.2 | 0.996 | 67.8 | -0.4 | 12.35 |
| mean | | | 0.990 | | ±1.9 | 15.19 |

Table 3. Water and crude fat content in lean dorsal meat of swordfish.

| Sample number | Apparent water content (in %) | Standard water content (in %) | Conversion factor | Water content found (in %) | Difference between the standard value and found value (in %) | Crude fat content (in %) |
|---------------|-------------------------------|-------------------------------|-------------------|----------------------------|--|--------------------------|
| 1 | 81.0 | 80.7 | 0.996 | 80.8 | +0.1 | 0.91 |
| 2 | 63.8 | 64.8 | 1.015 | 62.4 | -2.4 | 0.61 |
| 3 | 81.7 | 83.9 | 1.027 | 81.5 | -2.4 | 7.29 |
| 4 | 66.3 | 64.2 | 0.969 | 66.1 | +1.9 | 8.68 |
| 5 | 71.2 | 68.3 | 0.960 | 71.0 | +2.7 | 8.15 |
| 6 | 79.9 | 77.8 | 0.974 | 79.7 | +1.9 | 6.12 |
| 7 | 83.5 | 83.7 | 1.003 | 83.3 | -0.4 | 0.85 |
| 8 | 85.0 | 83.2 | 0.979 | 84.8 | +1.6 | 1.35 |
| 9 | 82.9 | 81.6 | 0.984 | 82.7 | +1.1 | 0.88 |
| 10 | 77.1 | 78.3 | 1.015 | 77.0 | -1.3 | 0.53 |
| 11 | 75.6 | 74.4 | 0.984 | 75.4 | +1.0 | 4.51 |
| 12 | 69.2 | 69.2 | 0.999 | 69.1 | -0.1 | 0.26 |
| 13 | 63.3 | 66.1 | 1.044 | 63.1 | -3.0 | 7.79 |
| 14 | 63.9 | 63.7 | 0.997 | 63.8 | +0.1 | 3.56 |
| 15 | 78.1 | 76.2 | 0.975 | 77.9 | +1.7 | 4.27 |
| 16 | 74.1 | 75.6 | 1.019 | 73.9 | -1.7 | 3.77 |
| 17 | 73.6 | 75.0 | 1.020 | 73.4 | -1.6 | 7.66 |
| 18 | 69.9 | 72.0 | 1.030 | 69.8 | -2.2 | 7.26 |
| 19 | 77.2 | 76.2 | 0.987 | 77.0 | +0.8 | 3.03 |
| 20 | 75.4 | 73.6 | 0.977 | 75.2 | +1.6 | 5.46 |
| mean | | | 0.998 | | ±1.5 | 4.15 |

Table 4. Water and crude fat content in fatty ventral meat of swordfish.

| Sample number | Apparent water content (in %) | Standard water content (in %) | Conversion factor | Water content found (in %) | Difference between the standard value and found value (in %) | Crude fat content (in %) |
|---------------|-------------------------------|-------------------------------|-------------------|----------------------------|--|--------------------------|
| 1 | 78.3 | 71.8 | 0.917 | 73.2 | +1.4 | 19.75 |
| 2 | 73.6 | 68.8 | 0.935 | 68.8 | ±0.0 | 14.76 |
| 3 | 77.2 | 67.7 | 0.877 | 72.2 | +4.5 | 23.91 |
| 4 | 67.6 | 62.7 | 0.928 | 63.2 | +0.5 | 21.14 |
| 5 | 59.9 | 66.9 | 1.116 | 56.0 | -10.9 | 20.87 |
| 6 | 66.9 | 63.4 | 0.947 | 62.6 | -0.8 | 12.76 |
| 7 | 78.5 | 72.6 | 0.925 | 73.4 | +0.8 | 16.13 |
| 8 | 69.7 | 65.0 | 0.927 | 65.1 | +0.1 | 10.93 |
| 9 | 68.8 | 63.2 | 0.919 | 64.3 | +1.1 | 19.51 |
| 10 | 66.4 | 62.2 | 0.937 | 62.1 | -0.1 | 12.26 |
| 11 | 70.0 | 65.2 | 0.932 | 65.4 | +0.2 | 14.44 |
| 12 | 69.4 | 66.8 | 0.963 | 64.9 | -1.9 | 17.91 |
| 13 | 68.8 | 64.5 | 0.938 | 64.3 | -0.2 | 13.40 |
| 14 | 75.0 | 67.1 | 0.881 | 70.1 | +3.0 | 21.59 |
| 15 | 67.5 | 62.3 | 0.923 | 63.1 | +0.8 | 14.65 |
| 16 | 67.1 | 64.5 | 0.961 | 62.7 | -1.8 | 15.64 |
| 17 | 69.5 | 63.1 | 0.908 | 65.0 | +1.9 | 19.89 |
| 18 | 66.6 | 59.3 | 0.876 | 62.3 | +3.0 | 21.95 |
| 19 | 68.6 | 65.5 | 0.955 | 64.1 | -1.4 | 15.56 |
| 20 | 76.1 | 70.8 | 0.931 | 71.1 | +0.3 | 12.38 |
| mean | | | 0.935 | | ±1.7 | 16.99 |

In the case of the saury, as seen in Tables 1 and 2, the factor is found to be 0.965 in the lean meat and 0.990 in the fatty dark meat. The mean fat content is 3.18 per cent in the former flesh and 15.19 per cent in the latter one. The average value of errors of estimation stands at $\pm 1.4\%$ and $\pm 1.9\%$ respectively. The coefficient of correlation between the error and fat content is given as +0.15 in the lean flesh and +0.47 in the fatty one. Thus it is of doubtful significance in the former but significant at the 5 per cent level in the latter.

In the case of the swordfish as shown in Tables 3 and 4, the factor is 0.935 in the fatty flesh and 0.998 in the lean one. The mean fat content is 16.99 per cent in the former and 4.15 per cent in the latter. The average value of errors stands at $\pm 1.7\%$ and $\pm 1.5\%$ respectively. The coefficient of correlation between the error of estimation and fat content is given as +0.65 in the fatty flesh and +0.57 in the lean one. Thus it is significant at the 1 per cent level in both meats.

Considering the results, it is concluded that the larger the fat content is the higher the error of moisture content becomes, but the errors of estimation are less than $\pm 1.9\%$ even in the case of fatty fish flesh. Therefore the methylalcohol dehydration method is generally applicable not only to the lean fish meat but also to the fatty one with small error.

Summary

The authors examined the relation between the error of estimation by the methylalcohol dehydration method and fat content of fish flesh. The method was proved to be applicable for determining the moisture content in fatty fish meat in a small error of $\pm 1.9\%$.

Reference

- (1) Y. Tsuchiya and T. Nakano (1954), *Tohoku Journal of Agricultural Research* 5, 93.