

PIG CARCASS CLASSIFICATION IN ROMANIA: A DISSECTION TRIAL FOR THE APPROVAL OF THE “FAT-O-MEAT’ER” AND OF THE “OPTIGRADE-PRO”EQUIPMENT

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Abstract

The objective of this study was to obtain new regression formulas for optical equipment Fat-O-Meat’er and OptiGrade-PRO in pig carcass classification in Romania. The estimation of lean mean content in pig carcasses by means of SEUROP system and following fair payment based on the weight and composition of the carcass pigs in the main objective of classification. Dissection of four main cuts (shoulder, loin, ham, belly) of pig carcasses (n = 145) were performed. The measurement of backfat and muscle depths using probes were taken from the carcasses within 45 min. after slaughter of pigs. Lean meat content estimated using different methods and determined from dissections was equal (56,3 %). There were calculated new regression formulas using the multiplied regression analysis. Correct regression formulas for classification equipments have a big importance. The requirements on accuracy of regression formulas are laid out in the Commission Regulation No 3127 / 94 and means of dissection according to the method by Walstra and Merkus (1996)

Key words: pig carcass classification, dissections, grading, lean meat, standard presentation

INTRODUCTION

In Romania, the Carcass Classification System for pig, bovine and ovine carcasses was established in 2004, by Government Decision; the functioning of the system is ensured by:

- The Carcass Classification Commission;
- Classification Agencies;
- Classifiers;
- Inspectors.

The Carcass Classification Commission manages and administers the classification system and ensures its application. Pig carcass classification is done in slaughter plants by independent classifiers or by employees of classification agencies. The carcass Classification Commission, under very strict conditions, the licenses of the classifiers and

the authorizations of the classification agencies, after they have been approved by Order of the Minister of Agriculture and Rural Development.

The classification activity in the slaughterhouses is controlled by 10 regional inspectors for classification of pig, bovine and ovine animals, coordinated by a chief inspector who has been nominated by Order of the Minister of Agriculture and Rural Development.

In Romania, pig carcass classification started in March 2006, using the optical probes Fat-O-Meat’er and OptiGrade-PRO and the ZP method applied with the ruler, which were authorized as a consequence of the two dissection trials, according to the technical norms in force.

The first dissection trial took place in 2003 at ROMSUINTEST Peris, for the approval of the Fat-O-Meat'er and of the ZP method, and the second one in 2005, at PRIMACOM Targu-Mures, for the approval of the OptiGrade-PRO.

Pig Carcass Classification is compulsory in Romania in all slaughterhouses, regardless of their size. [4]

Thus, slaughterhouses that slaughtered over 200 pig / week on an yearly average in the previous year must classify with an optical probe, either Fat-O-Meat'er, or OptiGrade-PRO. Slaughterhouses that slaughtered less than 200 pigs / week on a yearly average in the previous year may apply the ZP method.

In the first eight months of 2007, the Carcass Classification Commission recorded in its database complete data for 1,213,647 individual carcasses, regarding classification and prices.

These carcasses were classified into 125 slaughterhouses by 90 licensed classifiers.

A number of 33 classification agencies and 24 independent classifiers sent the data weekly to the Carcass Classification Commission.

The majority of the carcasses (78 %) were classified with the optical probes (Table 1).

Table 1. Carcasses classified between January 1st and August 31st, according to the method and equipment used

| Method | Equipment | Number of carcasses | % of total carcasses |
|---------------|---------------|---------------------|----------------------|
| Optical Probe | Fat-o-meat'er | 545,205 | 44,92 % |
| | OptiGrade-PRO | 402,219 | 33,14 % |
| ZP | - | 266,223 | 21,94 % |
| TOTAL | | 1,213,647 | 100,00 % |

The Romanian Pig Meat Association estimates that approximately 2,5 million pigs bred in specialized farms will be slaughtered in 2007 in slaughterhouses, which are obliged to classify.

The data stored in the first eight months of 2007 in the data base of the Carcass Classification Commission indicate an average lean meat percentage of 54,86 and a standard deviation of 3,92.

The mean weight of the hot carcass was of 80,27 kg and a standard deviation of 10,75 kg.

MATERIALS AND METHODS

The dissection trial was carried out in May-June 2007.

The selection of the carcasses was done by CCC, supervised by personnel from the Danish Meat Research Institute (DMRI), on the slaughter lines in Diana and Aldis.

The selection of the carcasses was done in principle at random.[3] However, the representability has been checked by measuring the thickness on the backfat. The distribution of the national population was split into 4 classes according to fat thickness on the back, measured with the ruler on the left half carcass, on the midline between the 3rd and the 4th last rib and the sample has been selected according to this (Table 2). The selected carcasses, well split into halves, weighing within the limits of the technical norms (50 – 120 kg), were put on a separate line where they were measured, on the left carcass side, at 7 cm from the split line, between the 3rd and the 4th last rib, with the Fat-o-meat'er and with the OptiGrade-PRO. The measurements were carried by four experienced classifiers according to a plan, specifying the rotation with respect to classifiers and instruments.

Table 2. Distribution of carcasses according to backfat thickness class

| Backfat thickness (mm) | ≤ 16 mm | 17 – 21 mm | 22 – 26 mm | ≥ 27 mm | Total |
|------------------------|---------|------------|------------|---------|-------|
| | 20 % | 30 % | 30 % | 20 % | |
| Total | 29 | 44 | 43 | 29 | 145 |

Carcasses were presented according to the EU standard presentation, with head and feet, without tongue, bristles, hooves, genital organs, flare fat, kidneys and diaphragm.[4] The carcasses from the dissection sample cover the variation of the national hot carcass weight between the 1 and 97 % percentiles (Fig 1.) and the mean hot carcass weight was 79,9 kg close to mean of the national population, see above.

The distribution of sexes was in total equal in the sample (72 females and 73 castrated males).

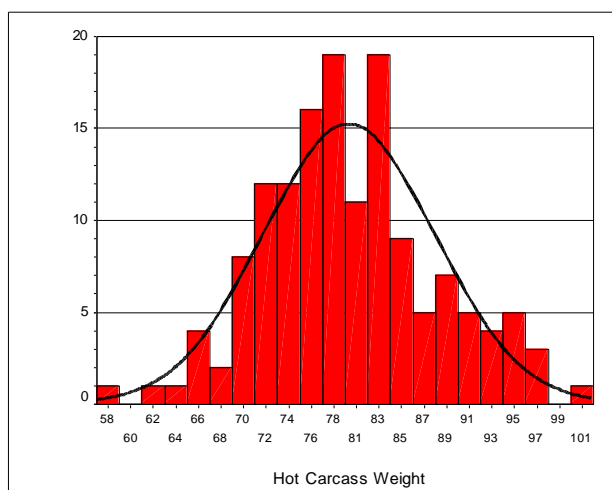


Fig 1. Histogram of the distribution of the hot carcass weight (trial)

The intention was to obtain a sample representing as many large producers as possible in order to cover the national biological variation. It succeeded in selecting 145 carcasses from 14 farms (Table 3.) situated in different regions of Romania.

Table 3. The distribution of the carcasses by suppliers and genders [1]

| | | SEX | | Total |
|----------|-------------------|----------|---------------|--------|
| | | Fe-males | Castred males | |
| SUPPLIER | Count | 1 | 4 | 5 |
| | % within SUPPLIER | 20.0 % | 80.0 % | 100.0% |
| | % within SEX | 1.4 % | 5.5 % | 3.4 % |
| | % of Total | 0.7 % | 2.8 % | 3.4 % |
| 1 | Count | 6 | 15 | 21 |
| | % within SUPPLIER | 28.6 % | 71.4 % | 100.0% |
| | % within SEX | 8.3 % | 20.5 % | 14.5 % |
| | % of Total | 4.1 % | 10.3 % | 14.5 % |
| 2 | Count | 3 | 3 | 6 |
| | % within SUPPLIER | 50.0 % | 50.0 % | 100.0% |
| | % within SEX | 4.2 % | 4.1 % | 4.1 % |
| | % of Total | 2.1 % | 2.1 % | 4.1 % |
| 3 | Count | 3 | 3 | 6 |
| | % within SUPPLIER | 50.0 % | 50.0 % | 100.0% |
| | % within SEX | 4.2 % | 4.1 % | 4.1 % |
| | % of Total | 2.1 % | 2.1 % | 4.1 % |
| 4 | Count | 7 | 8 | 15 |
| | % within SUPPLIER | 46.7 % | 53.3 % | 100.0% |
| | % within SEX | 9.7 % | 11.0 % | 10.3 % |
| | % of Total | 4.8 % | 5.5 % | 10.3 % |
| 6 | Count | 7 | 5 | 12 |
| | % within | 58.3 % | 41.7 % | 100.0% |

| | | | | |
|-------|-------------------|--------|--------|--------|
| | SUPPLIER | | | |
| | % within SEX | 9.7 % | 6.8 % | 8.3 % |
| | % of Total | 4.8 % | 3.4 % | 8.3 % |
| 7 | Count | 5 | 1 | 6 |
| | % within SUPPLIER | 83.3 % | 16.7 % | 100.0% |
| | % within SEX | 6.9 % | 1.4 % | 4.1 % |
| | % of Total | 3.4 % | 0.7 % | 4.1 % |
| 8 | Count | 3 | 7 | 10 |
| | % within SUPPLIER | 30.0 % | 70.0 % | 100.0% |
| | % within SEX | 4.2 % | 9.6 % | 6.9 % |
| | % of Total | 2.1 % | 4.8 % | 6.9 % |
| 9 | Count | 7 | 7 | 14 |
| | % within SUPPLIER | 50.0 % | 50.0 % | 100.0% |
| | % within SEX | 9.7 % | 9.6 % | 9.7 % |
| | % of Total | 4.8 % | 4.8 % | 9.7 % |
| 10 | Count | 10 | 2 | 12 |
| | % within SUPPLIER | 83.3 % | 16.7 % | 100.0% |
| | % within SEX | 13.9 % | 2.7 % | 8.3 % |
| | % of Total | 6.9 % | 1.4 % | 8.3 % |
| 11 | Count | 1 | 5 | 6 |
| | % within SUPPLIER | 16.7 % | 83.3 % | 100.0% |
| | % within SEX | 1.4 % | 6.8 % | 4.1 % |
| | % of Total | 0.7 % | 3.4 % | 4.1 % |
| 12 | Count | 11 | 2 | 13 |
| | % within SUPPLIER | 84.6 % | 15.4 % | 100.0% |
| | % within SEX | 15.3 % | 2.7 % | 9.0 % |
| | % of Total | 7.6 % | 1.4 % | 9.0 % |
| 13 | Count | 1 | 5 | 6 |
| | % within SUPPLIER | 16.7 % | 83.3 % | 100.0% |
| | % within SEX | 1.4 % | 6.8 % | 4.1 % |
| | % of Total | 0.7 % | 3.4 % | 4.1 % |
| 14 | Count | 7 | 6 | 13 |
| | % within SUPPLIER | 53.8 % | 46.2 % | 100.0% |
| | % within SEX | 9.7 % | 8.2 % | 9.0 % |
| | % of Total | 4.8 % | 4.1 % | 9.0 % |
| Total | Count | 72 | 73 | 145 |
| | % within SUPPLIER | 49.7 % | 50.3 % | 100.0% |
| | % within SEX | 100 % | 100 % | 100.0% |
| | % of Total | 49.7 % | 50.3 % | 100.0% |

Dissection was carried out at ALDIS slaughterhouse, in a separate room, within 24 – 48 hours from slaughter, under perfect chilling conditions (temperature under 10⁰). The jointing of the carcass was done by the same experienced butcher according to the EU reference method for the dissection (Walstra and Merkus, 1996) [3]. The dissection of the four main parts of the carcasses was done by

10 butchers. The dissection was supervised during the entire period by an expert from DMRI (Århus University). The data were recorded by staff from the Carcass Classification Commission. The descriptive statistics of the dissected carcasses are presented in Table 4.

Table 4. Descriptive statistics of the dissected carcasses (n=145) [5]

| Trait | Average | Standard deviation | Minimum | Maximum |
|--|---------|--------------------|---------|---------|
| Hot carcass weight, kg | 79.90 | 7.77 | 58.60 | 100.7 |
| Cold half carcass, kg | 39.30 | 3.87 | 28.50 | 50.40 |
| Dissected lean meat, % ("old" reference) | 54.36 | 5.53 | 37.23 | 65.51 |
| Dissected lean meat, % (2006 reference) | 56.30 | 5.30 | 38.61 | 66.89 |
| X1 FOM, mm | 18.00 | 4.71 | 10.00 | 32.00 |
| X2 FOM, mm | 53.30 | 8.09 | 37.00 | 74.00 |
| X1 OGP, mm | 16.50 | 4.95 | 9.40 | 30.80 |
| X2 OGP, mm | 52.00 | 9.88 | 32.10 | 82.20 |

RESULTS AND DISCUSSIONS

The calculation of the lean meat percentage in the carcass was carried out according to Commission Regulation (EEC) 2967 / 85 (modified by (EC) 3127 / 94 and (EC) 1197 / 2006), which established detailed rules for the application of the community grid for pig carcass classification. [5, 6] In order to make comparisons, the lean meat percentage was also calculated according to the "old" reference (Commission Regulation (EC) 3127 / 94). [6]

The old reference is almost perfectly "explained" by the new reference. The lean meat percentage is characterized by a slight asymmetry of the value distribution, which is considered to be a normal distribution (Fig 2.).

The root mean squared error of prediction (RMSEP) was calculated by a "cross-validation" technique, the "leave one out" method, on all data (n = 145), for both equipment. The root mean squared error (RMSE) and the coefficient of determination (R²) are also presented. No carcasses were removed from the sample in order to calculate the prediction formulas with which the equipment will be calibrated.

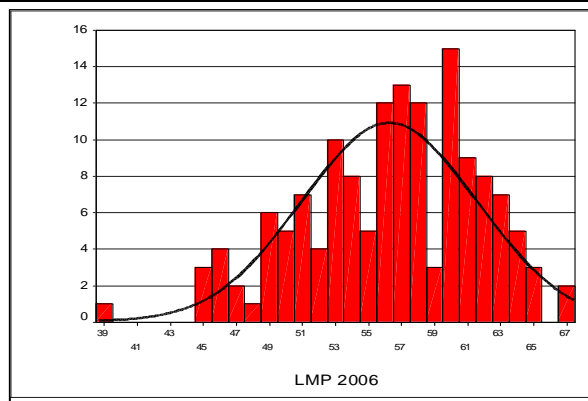


Fig 2. Histogram of the distribution of the dissected lean meat % (2006 reference)

The method of linear regression has been applied to calculate the prediction formula for the two optical probes, by use of the statistic application SPSS 10.0 under Windows.[2] The calculations have been carried out by the experts of the Carcass Classification Commission supervised by experts from the Danish Meat Research Institute.

The measurements with the two optical probes, the lean meat percentages obtained with the "new" and "old" reference and the lean meat percentage predictions are presented in tables 5 and 6.

Table 5. Number, trial number, sex (F = female, C = castrated male), hot carcass weight (kg), measured fat thickness (X₁, mm) and muscle thickness (X₂, mm) with FOM and OGP (n = 145)

| N ^o | Trial N ^o | Sex | Hot carcass weight | FOM | | OGP | |
|----------------|----------------------|-----|--------------------|----------------|----------------|----------------|----------------|
| | | | | X ₁ | X ₂ | X ₁ | X ₂ |
| 1 | 2 | C | 77.0 | 16 | 63 | 15.6 | 63.1 |
| 2 | 4 | C | 82.0 | 20 | 59 | 16.9 | 54.4 |
| 3 | 5 | F | 77.0 | 14 | 64 | 13.2 | 63.1 |
| 4 | 6 | C | 82.0 | 17 | 61 | 15.0 | 56.7 |
| 5 | 7 | C | 77.0 | 16 | 52 | 11.9 | 50.6 |
| 6 | 10 | C | 74.0 | 16 | 63 | 14.0 | 61.0 |
| 7 | 11 | F | 74.0 | 12 | 60 | 9.9 | 50.6 |
| 8 | 12 | C | 77.0 | 12 | 64 | 9.5 | 61.2 |
| 9 | 13 | C | 79.0 | 13 | 65 | 12.5 | 60.0 |
| 10 | 14 | F | 83.0 | 16 | 58 | 13.4 | 44.4 |
| 11 | 15 | F | 97.4 | 23 | 58 | 20.8 | 59.8 |
| 12 | 16 | F | 95.2 | 24 | 58 | 20.6 | 67.8 |
| 13 | 17 | F | 65.2 | 15 | 52 | 10.9 | 57.7 |

| | | | | | | | | | | | | | | | |
|----|----|---|------|----|----|------|------|-----|-----|---|-------|----|----|------|------|
| 14 | 18 | F | 78.5 | 12 | 55 | 9.4 | 56.3 | 58 | 82 | F | 72.8 | 15 | 54 | 13.8 | 53.2 |
| 15 | 20 | F | 76.6 | 12 | 52 | 10.3 | 51.6 | 59 | 83 | C | 77.0 | 13 | 55 | 10.7 | 54.4 |
| 16 | 21 | F | 73.8 | 14 | 51 | 12.5 | 49.9 | 60 | 84 | C | 76.0 | 17 | 61 | 13.4 | 60.4 |
| 17 | 22 | F | 80.0 | 20 | 58 | 21.8 | 47.1 | 61 | 85 | C | 67.8 | 12 | 49 | 11.7 | 49.1 |
| 18 | 23 | C | 70.8 | 17 | 47 | 14.0 | 42.9 | 62 | 87 | F | 86.6 | 14 | 58 | 12.3 | 62.5 |
| 19 | 24 | C | 74.6 | 16 | 56 | 19.7 | 45.0 | 63 | 88 | F | 84.4 | 18 | 57 | 17.9 | 58.6 |
| 20 | 27 | F | 73.0 | 14 | 52 | 11.7 | 45.4 | 64 | 89 | C | 88.2 | 13 | 54 | 10.9 | 51.6 |
| 21 | 30 | C | 83.0 | 14 | 55 | 13.6 | 48.7 | 65 | 90 | F | 63.0 | 14 | 47 | 12.1 | 50.5 |
| 22 | 33 | C | 82.5 | 16 | 67 | 14.8 | 58.4 | 66 | 92 | C | 81.0 | 21 | 55 | 21.0 | 56.5 |
| 23 | 34 | C | 84.0 | 22 | 58 | 22.4 | 42.1 | 67 | 93 | C | 94.0 | 25 | 54 | 24.5 | 52.4 |
| 24 | 35 | F | 72.8 | 10 | 53 | 10.1 | 49.9 | 68 | 94 | F | 70.0 | 11 | 50 | 10.3 | 47.9 |
| 25 | 36 | F | 86.0 | 14 | 63 | 12.5 | 53.8 | 69 | 95 | F | 70.2 | 17 | 41 | 15.0 | 49.9 |
| 26 | 37 | F | 80.0 | 12 | 53 | 10.1 | 54.9 | 70 | 96 | F | 72.5 | 16 | 48 | 15.0 | 47.3 |
| 27 | 38 | F | 90.5 | 17 | 45 | 13.4 | 59.8 | 71 | 97 | F | 74.7 | 23 | 49 | 21.6 | 48.3 |
| 28 | 39 | C | 83.5 | 21 | 45 | 16.9 | 53.0 | 72 | 99 | C | 58.6 | 14 | 37 | 12.7 | 35.1 |
| 29 | 40 | C | 90.0 | 20 | 46 | 19.9 | 45.8 | 73 | 101 | F | 91.0 | 18 | 63 | 15.4 | 58.6 |
| 30 | 41 | F | 92.8 | 26 | 47 | 23.4 | 53.8 | 74 | 102 | C | 97.1 | 17 | 57 | 15.6 | 56.9 |
| 31 | 42 | C | 88.9 | 17 | 48 | 13.4 | 60.0 | 75 | 103 | F | 78.4 | 17 | 59 | 13.4 | 53.4 |
| 32 | 46 | F | 80.4 | 15 | 57 | 13.4 | 58.4 | 76 | 105 | C | 89.1 | 19 | 58 | 16.9 | 53.6 |
| 33 | 48 | F | 81.0 | 14 | 48 | 13.1 | 54.7 | 77 | 108 | F | 71.3 | 20 | 43 | 19.9 | 32.1 |
| 34 | 50 | F | 76.6 | 18 | 46 | 15.6 | 47.5 | 78 | 109 | C | 77.4 | 25 | 41 | 23.4 | 35.3 |
| 35 | 51 | C | 89.1 | 29 | 45 | 29.4 | 41.7 | 79 | 110 | F | 73.0 | 17 | 38 | 17.5 | 32.3 |
| 36 | 53 | C | 78.0 | 16 | 42 | 16.4 | 41.3 | 80 | 111 | C | 100.7 | 29 | 44 | 28.2 | 37.2 |
| 37 | 54 | C | 81.4 | 29 | 42 | 28.6 | 36.0 | 81 | 112 | F | 77.2 | 21 | 41 | 23.6 | 33.9 |
| 38 | 55 | F | 74.5 | 24 | 48 | 21.6 | 50.5 | 82 | 113 | F | 86.0 | 29 | 46 | 27.5 | 42.3 |
| 39 | 57 | F | 88.7 | 15 | 74 | 15.4 | 71.7 | 83 | 114 | F | 76.6 | 21 | 37 | 20.1 | 34.5 |
| 40 | 58 | F | 83.9 | 17 | 66 | 15.2 | 69.4 | 84 | 116 | C | 70.5 | 17 | 38 | 14.4 | 32.9 |
| 41 | 59 | F | 82.8 | 14 | 63 | 12.7 | 61.4 | 85 | 117 | F | 87.3 | 16 | 65 | 13.1 | 68.6 |
| 42 | 60 | F | 76.0 | 17 | 52 | 15.4 | 57.5 | 86 | 118 | F | 74.2 | 12 | 62 | 10.3 | 63.1 |
| 43 | 61 | F | 75.7 | 11 | 58 | 9.5 | 60.6 | 87 | 119 | F | 84.2 | 18 | 49 | 16.2 | 47.9 |
| 44 | 62 | C | 69.2 | 20 | 57 | 20.3 | 57.7 | 88 | 120 | F | 92.1 | 15 | 66 | 12.3 | 63.1 |
| 45 | 63 | F | 78.7 | 15 | 52 | 11.9 | 53.2 | 89 | 121 | C | 97.5 | 13 | 58 | 11.7 | 62.5 |
| 46 | 65 | C | 82.5 | 15 | 64 | 13.1 | 67.0 | 90 | 122 | F | 76.1 | 14 | 53 | 12.1 | 56.3 |
| 47 | 66 | F | 73.0 | 17 | 48 | 15.4 | 51.6 | 91 | 123 | C | 93.7 | 23 | 58 | 20.1 | 60.4 |
| 48 | 67 | F | 70.5 | 13 | 60 | 11.1 | 58.4 | 92 | 124 | F | 94.0 | 24 | 64 | 22.2 | 67.0 |
| 49 | 68 | C | 71.4 | 14 | 53 | 13.2 | 48.3 | 93 | 125 | F | 82.3 | 13 | 66 | 10.5 | 62.5 |
| 50 | 70 | C | 82.6 | 19 | 64 | 16.4 | 53.2 | 94 | 144 | C | 76.2 | 19 | 45 | 18.3 | 44.6 |
| 51 | 71 | C | 83.4 | 17 | 51 | 16.6 | 57.9 | 95 | 146 | C | 70.5 | 13 | 62 | 11.7 | 56.9 |
| 52 | 73 | F | 83.0 | 16 | 63 | 20.5 | 66.2 | 96 | 147 | C | 72.1 | 12 | 63 | 11.9 | 56.9 |
| 53 | 74 | C | 88.7 | 22 | 63 | 18.5 | 71.7 | 97 | 148 | C | 73.0 | 18 | 59 | 16.4 | 54.9 |
| 54 | 76 | C | 73.8 | 20 | 53 | 18.9 | 54.2 | 98 | 149 | C | 78.3 | 17 | 66 | 15.2 | 61.8 |
| 55 | 77 | C | 94.0 | 17 | 58 | 15.0 | 54.0 | 99 | 150 | C | 63.6 | 15 | 59 | 14.0 | 44.6 |
| 56 | 78 | F | 77.0 | 17 | 53 | 14.8 | 56.1 | 100 | 151 | C | 73.8 | 18 | 41 | 17.5 | 39.9 |
| 57 | 79 | C | 81.0 | 18 | 51 | 19.9 | 39.7 | 101 | 152 | C | 84.0 | 23 | 55 | 18.7 | 50.6 |

| | | | | | | | |
|-----|-----|---|------|----|----|------|------|
| 102 | 153 | F | 79.2 | 17 | 48 | 14.2 | 48.7 |
| 103 | 154 | C | 71.0 | 20 | 47 | 18.3 | 46.0 |
| 104 | 155 | C | 72.0 | 15 | 53 | 13.8 | 50.6 |
| 105 | 156 | C | 84.5 | 19 | 46 | 16.2 | 48.5 |
| 106 | 157 | C | 81.7 | 17 | 44 | 15.4 | 40.9 |
| 107 | 158 | F | 75.3 | 32 | 38 | 30.6 | 38.8 |
| 108 | 159 | C | 79.2 | 15 | 55 | 12.7 | 48.3 |
| 109 | 160 | F | 80.8 | 22 | 58 | 22.2 | 41.7 |
| 110 | 161 | F | 88.4 | 20 | 54 | 19.5 | 52.4 |
| 111 | 162 | F | 81.8 | 31 | 45 | 30.8 | 34.7 |
| 112 | 163 | F | 85.8 | 22 | 58 | 19.1 | 51.8 |
| 113 | 164 | C | 79.4 | 23 | 54 | 20.3 | 41.1 |
| 114 | 165 | F | 78.0 | 17 | 62 | 15.6 | 66.4 |
| 115 | 167 | F | 71.4 | 13 | 56 | 10.9 | 60.6 |
| 116 | 169 | F | 84.1 | 15 | 64 | 13.1 | 60.0 |
| 117 | 171 | F | 89.8 | 15 | 57 | 11.9 | 55.3 |
| 118 | 177 | C | 80.3 | 28 | 53 | 24.7 | 48.5 |
| 119 | 179 | C | 71.9 | 24 | 44 | 24.4 | 42.5 |
| 120 | 181 | C | 78.0 | 26 | 48 | 25.1 | 44.6 |
| 121 | 183 | C | 83.3 | 25 | 37 | 20.8 | 34.1 |
| 122 | 184 | F | 78.6 | 32 | 45 | 29.6 | 35.5 |
| 123 | 186 | C | 66.3 | 21 | 37 | 20.5 | 37.4 |
| 124 | 189 | F | 78.3 | 18 | 53 | 17.5 | 50.5 |
| 125 | 190 | F | 94.2 | 23 | 51 | 26.1 | 47.7 |
| 126 | 192 | F | 67.0 | 12 | 51 | 9.4 | 51.0 |
| 127 | 193 | C | 79.4 | 24 | 52 | 22.4 | 50.1 |
| 128 | 194 | F | 78.7 | 12 | 59 | 10.9 | 82.2 |
| 129 | 195 | F | 84.9 | 13 | 59 | 11.9 | 71.5 |
| 130 | 197 | F | 84.8 | 17 | 63 | 16.4 | 71.1 |
| 131 | 198 | C | 79.1 | 21 | 61 | 17.9 | 63.1 |
| 132 | 203 | C | 82.8 | 13 | 55 | 11.9 | 52.0 |
| 133 | 205 | C | 77.9 | 16 | 57 | 13.4 | 51.0 |
| 134 | 207 | C | 90.0 | 17 | 64 | 16.0 | 58.8 |
| 135 | 208 | C | 80.8 | 16 | 62 | 14.4 | 59.0 |
| 136 | 209 | C | 92.2 | 20 | 50 | 18.3 | 43.8 |
| 137 | 210 | F | 73.4 | 17 | 40 | 16.6 | 38.6 |
| 138 | 211 | F | 78.5 | 22 | 38 | 22.8 | 33.3 |
| 139 | 213 | C | 73.6 | 14 | 43 | 12.7 | 40.5 |
| 140 | 214 | F | 81.8 | 21 | 44 | 20.1 | 48.3 |
| 141 | 215 | C | 81.5 | 21 | 53 | 18.9 | 47.3 |
| 142 | 216 | C | 77.8 | 16 | 38 | 13.8 | 70.5 |
| 143 | 217 | C | 65.4 | 20 | 42 | 17.1 | 36.6 |
| 144 | 218 | C | 82.7 | 19 | 54 | 19.7 | 53.6 |
| 145 | 221 | c | 83.2 | 27 | 51 | 23.6 | 46.0 |

Table 6. Number, trial number, dissected lean meat percentage according to the “old” reference (“old” LMP) and the actual reference (LMP 2006) and predicted lean meat percentage with the equipments Fat-O Meat’er and OptiGrade-PRO (n = 145)

| N° | Trial N° | “old” LMP | LMP 2006 | LMP FOM | LMP OGP |
|----|----------|-----------|----------|---------|---------|
| 1 | 2 | 56.95 | 58.00 | 59.92 | 58.73 |
| 2 | 4 | 51.74 | 53.24 | 55.86 | 56.41 |
| 3 | 5 | 58.90 | 61.73 | 61.72 | 60.56 |
| 4 | 6 | 58.30 | 59.43 | 58.66 | 58.20 |
| 5 | 7 | 53.21 | 55.58 | 57.70 | 59.75 |
| 6 | 10 | 55.53 | 57.26 | 59.94 | 59.67 |
| 7 | 11 | 59.01 | 61.32 | 62.57 | 61.24 |
| 8 | 12 | 60.75 | 63.95 | 63.34 | 63.15 |
| 9 | 13 | 58.04 | 59.81 | 62.81 | 60.67 |
| 10 | 14 | 61.12 | 63.04 | 58.85 | 57.47 |
| 11 | 15 | 53.82 | 55.93 | 53.12 | 54.13 |
| 12 | 16 | 56.39 | 57.83 | 52.21 | 55.44 |
| 13 | 17 | 59.79 | 62.74 | 58.45 | 61.53 |
| 14 | 18 | 62.84 | 64.43 | 61.49 | 62.46 |
| 15 | 20 | 61.39 | 63.76 | 60.88 | 61.02 |
| 16 | 21 | 58.56 | 61.60 | 59.07 | 59.08 |
| 17 | 22 | 51.42 | 53.33 | 55.65 | 51.44 |
| 18 | 23 | 52.93 | 56.68 | 55.85 | 56.89 |
| 19 | 24 | 51.82 | 53.48 | 58.53 | 52.77 |
| 20 | 27 | 56.71 | 59.56 | 59.31 | 59.04 |
| 21 | 30 | 52.19 | 55.53 | 59.97 | 58.11 |
| 22 | 33 | 53.99 | 54.05 | 60.88 | 58.67 |
| 23 | 34 | 48.75 | 49.68 | 54.08 | 50.25 |
| 24 | 35 | 60.89 | 63.07 | 62.76 | 60.93 |
| 25 | 36 | 56.24 | 58.47 | 61.58 | 59.72 |
| 26 | 37 | 61.48 | 63.44 | 61.09 | 61.71 |
| 27 | 38 | 53.16 | 57.21 | 55.43 | 59.96 |
| 28 | 39 | 51.78 | 54.76 | 52.16 | 56.18 |
| 29 | 40 | 53.23 | 55.60 | 53.18 | 52.71 |
| 30 | 41 | 47.58 | 49.24 | 48.50 | 51.30 |
| 31 | 42 | 52.32 | 55.69 | 56.06 | 60.01 |
| 32 | 46 | 57.26 | 60.88 | 59.49 | 59.70 |
| 33 | 48 | 57.53 | 60.04 | 58.48 | 59.37 |
| 34 | 50 | 52.07 | 54.87 | 54.84 | 56.36 |
| 35 | 51 | 46.52 | 49.34 | 45.50 | 44.48 |
| 36 | 53 | 48.86 | 53.15 | 55.74 | 54.80 |
| 37 | 54 | 41.68 | 44.64 | 45.10 | 44.49 |
| 38 | 55 | 50.57 | 52.90 | 50.31 | 52.13 |
| 39 | 57 | 59.46 | 59.78 | 63.09 | 60.20 |
| 40 | 58 | 62.07 | 63.21 | 59.59 | 59.89 |
| 41 | 59 | 63.44 | 64.24 | 61.47 | 60.66 |
| 42 | 60 | 61.61 | 62.35 | 56.82 | 57.98 |
| 43 | 61 | 64.40 | 66.64 | 62.88 | 63.00 |
| 44 | 62 | 54.15 | 56.03 | 55.42 | 54.21 |
| 45 | 63 | 56.44 | 58.07 | 58.50 | 60.11 |
| 46 | 65 | 59.52 | 60.14 | 60.92 | 61.28 |
| 47 | 66 | 53.93 | 56.80 | 56.05 | 57.12 |
| 48 | 67 | 60.98 | 63.39 | 61.71 | 61.47 |
| 49 | 68 | 54.48 | 56.96 | 59.54 | 58.35 |
| 50 | 70 | 54.32 | 57.42 | 57.65 | 56.58 |
| 51 | 71 | 52.45 | 54.25 | 56.68 | 57.18 |
| 52 | 73 | 58.65 | 61.59 | 59.86 | 55.13 |
| 53 | 74 | 54.84 | 56.05 | 54.97 | 57.87 |
| 54 | 76 | 52.97 | 55.02 | 54.62 | 54.80 |
| 55 | 77 | 55.17 | 57.32 | 58.08 | 57.80 |
| 56 | 78 | 56.77 | 59.56 | 57.05 | 58.26 |
| 57 | 79 | 48.56 | 50.06 | 55.89 | 51.85 |
| 58 | 82 | 56.97 | 57.88 | 58.91 | 58.62 |
| 59 | 83 | 57.72 | 60.50 | 60.73 | 61.21 |
| 60 | 84 | 58.40 | 60.66 | 58.65 | 60.01 |
| 61 | 85 | 59.59 | 61.78 | 60.30 | 59.57 |
| 62 | 87 | 60.06 | 62.34 | 60.49 | 61.17 |

| | | | | | |
|-----|-----|-------|-------|-------|-------|
| 63 | 88 | 54.67 | 58.06 | 57.05 | 56.22 |
| 64 | 89 | 58.23 | 61.84 | 60.51 | 60.59 |
| 65 | 90 | 57.70 | 59.54 | 58.28 | 59.52 |
| 66 | 92 | 52.25 | 53.43 | 54.22 | 53.52 |
| 67 | 93 | 49.35 | 51.06 | 50.74 | 50.15 |
| 68 | 94 | 60.29 | 61.70 | 61.34 | 60.49 |
| 69 | 95 | 52.87 | 55.57 | 54.63 | 57.19 |
| 70 | 96 | 51.52 | 54.43 | 56.91 | 56.80 |
| 71 | 97 | 49.66 | 51.35 | 51.37 | 51.81 |
| 72 | 99 | 53.14 | 55.93 | 56.32 | 56.74 |
| 73 | 101 | 57.28 | 59.92 | 58.23 | 58.17 |
| 74 | 102 | 58.70 | 59.74 | 57.85 | 57.76 |
| 75 | 103 | 57.37 | 60.70 | 58.25 | 58.93 |
| 76 | 105 | 55.15 | 57.30 | 56.43 | 56.25 |
| 77 | 108 | 46.52 | 50.64 | 52.65 | 50.66 |
| 78 | 109 | 45.46 | 49.18 | 48.10 | 48.40 |
| 79 | 110 | 53.32 | 55.91 | 53.98 | 52.41 |
| 80 | 111 | 43.27 | 44.90 | 45.50 | 44.99 |
| 81 | 112 | 45.11 | 47.36 | 51.49 | 48.08 |
| 82 | 113 | 42.72 | 45.98 | 45.87 | 46.32 |
| 83 | 114 | 46.57 | 51.46 | 50.56 | 50.85 |
| 84 | 116 | 50.51 | 55.31 | 54.00 | 55.04 |
| 85 | 117 | 65.51 | 64.90 | 60.19 | 61.41 |
| 86 | 118 | 65.40 | 66.89 | 62.86 | 62.75 |
| 87 | 119 | 53.12 | 55.39 | 55.45 | 55.94 |
| 88 | 120 | 65.22 | 63.65 | 61.25 | 61.24 |
| 89 | 121 | 63.46 | 64.54 | 61.28 | 61.61 |
| 90 | 122 | 58.41 | 60.26 | 59.50 | 60.40 |
| 91 | 123 | 53.00 | 53.29 | 53.18 | 54.85 |
| 92 | 124 | 54.45 | 54.38 | 53.53 | 54.18 |
| 93 | 125 | 65.49 | 65.24 | 62.88 | 62.54 |
| 94 | 144 | 47.31 | 51.65 | 53.86 | 53.83 |
| 95 | 146 | 60.37 | 62.55 | 62.13 | 60.78 |
| 96 | 147 | 57.70 | 59.83 | 63.23 | 60.66 |
| 97 | 148 | 56.51 | 57.09 | 57.46 | 56.85 |
| 98 | 149 | 61.25 | 60.66 | 59.65 | 58.81 |
| 99 | 150 | 57.13 | 59.06 | 59.91 | 57.11 |
| 100 | 151 | 50.44 | 54.12 | 53.83 | 53.70 |
| 101 | 152 | 53.90 | 56.82 | 52.50 | 54.39 |
| 102 | 153 | 56.45 | 58.26 | 56.03 | 57.60 |
| 103 | 154 | 54.89 | 57.09 | 53.37 | 53.99 |
| 104 | 155 | 57.61 | 59.85 | 58.68 | 58.20 |
| 105 | 156 | 50.83 | 52.20 | 54.05 | 56.06 |
| 106 | 157 | 49.84 | 52.55 | 55.31 | 55.55 |
| 107 | 158 | 45.33 | 46.46 | 41.46 | 43.16 |
| 108 | 159 | 55.23 | 56.75 | 59.12 | 58.75 |
| 109 | 160 | 50.46 | 53.51 | 54.00 | 50.27 |
| 110 | 161 | 53.93 | 56.32 | 54.81 | 54.04 |
| 111 | 162 | 37.23 | 38.61 | 44.39 | 42.87 |
| 112 | 163 | 51.42 | 52.66 | 54.02 | 54.29 |
| 113 | 164 | 46.86 | 49.04 | 52.43 | 51.76 |
| 114 | 165 | 57.01 | 59.24 | 58.87 | 59.22 |
| 115 | 167 | 58.76 | 61.09 | 60.93 | 62.00 |
| 116 | 169 | 57.07 | 57.94 | 60.96 | 60.22 |
| 117 | 171 | 60.45 | 60.82 | 59.49 | 60.40 |
| 118 | 177 | 44.75 | 46.32 | 48.18 | 49.51 |
| 119 | 179 | 44.38 | 45.31 | 49.65 | 48.83 |
| 120 | 181 | 47.39 | 48.74 | 48.72 | 48.52 |
| 121 | 183 | 48.10 | 49.62 | 47.24 | 50.28 |
| 122 | 184 | 45.96 | 46.66 | 42.98 | 43.46 |
| 123 | 186 | 44.85 | 46.28 | 50.75 | 51.10 |
| 124 | 189 | 54.25 | 54.30 | 56.26 | 55.33 |
| 125 | 190 | 50.87 | 52.77 | 51.76 | 48.06 |
| 126 | 192 | 58.64 | 60.40 | 60.75 | 61.73 |
| 127 | 193 | 49.53 | 51.35 | 51.16 | 51.46 |
| 128 | 194 | 59.90 | 61.15 | 62.37 | 65.60 |
| 129 | 195 | 56.66 | 57.86 | 61.59 | 63.05 |
| 130 | 197 | 59.66 | 58.39 | 59.09 | 59.35 |
| 131 | 198 | 57.48 | 56.86 | 55.38 | 56.93 |
| 132 | 203 | 58.66 | 60.00 | 60.74 | 59.90 |
| 133 | 205 | 56.52 | 57.99 | 58.69 | 58.59 |

| | | | | | |
|-----|-----|-------|-------|-------|-------|
| 134 | 207 | 54.75 | 55.66 | 59.35 | 57.78 |
| 135 | 208 | 57.48 | 57.66 | 59.72 | 59.04 |
| 136 | 209 | 49.78 | 50.83 | 54.05 | 53.72 |
| 137 | 210 | 51.01 | 53.60 | 54.48 | 54.22 |
| 138 | 211 | 46.82 | 50.82 | 49.95 | 48.51 |
| 139 | 213 | 57.94 | 59.54 | 57.43 | 57.46 |
| 140 | 214 | 46.42 | 50.00 | 52.03 | 53.00 |
| 141 | 215 | 49.47 | 49.81 | 53.85 | 53.78 |
| 142 | 216 | 49.45 | 51.76 | 55.00 | 61.56 |
| 143 | 217 | 47.17 | 48.39 | 52.49 | 53.66 |
| 144 | 218 | 51.75 | 52.01 | 55.66 | 54.11 |
| 145 | 221 | 46.26 | 48.57 | 48.51 | 49.93 |

1. Fat-O-Meat'er (FOM)

N = 145

$R^2 = 0.78288$

RMSE = 2.48840

$Y = 60.26989 - 0.81506 * X_1 + 0.20097 * X_2$

RMSEP = 2.51938 ~ 2.5

Y = predicted lean meat percentage

X_1 = thickness of fat, including rind, in millimeters, measured at 7 cm from the midline, between the 3rd and the 4th last rib

X_2 = thickness of the muscles in millimeters, measured at 7 cm from the midline, between the 3rd and the 4th last rib.

2. OptiGrade-PRO

N = 145

$R^2 = 0.79425$

RMSE = 2.42238

$Y = 61.21920 - 0.77665 * X_1 + 0.15239 * X_2$

RMSEP = 2.45933 ~ 2.5

Y = predicted lean meat percentage

X_1 = thickness of fat, including rind, in millimeters, measured at 7 cm from the midline, between the 3rd and the 4th last rib

X_2 = thickness of the muscles in millimeters, measured at 7 cm from the midline, between the 3rd and the 4th last rib.

Graphs illustrating lean meat percentage predictions with FOM and OGP (n = 145) are presented below.[6]

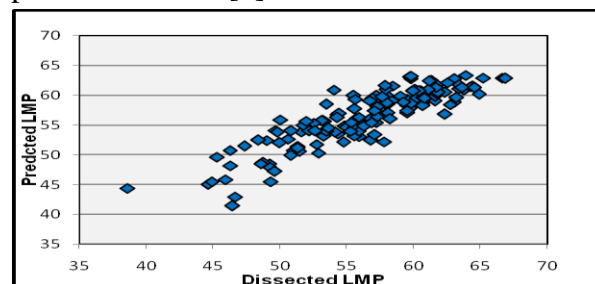


Fig 3. Predicted versus dissected lean meat percentage (LMP) for FOM

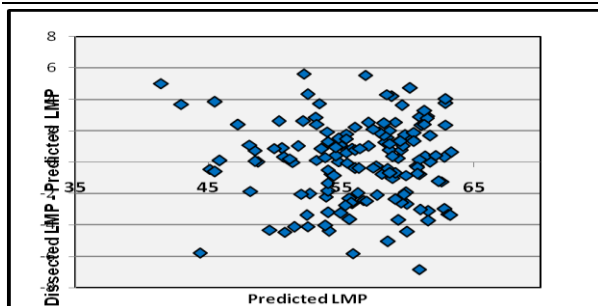


Fig 4. Residuals versus predicted lean meat percentage (LMP) for FOM

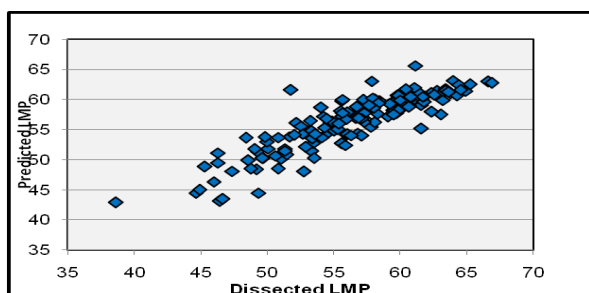


Fig 5. Predicted versus dissected lean meat percentage (LMP) for OGP

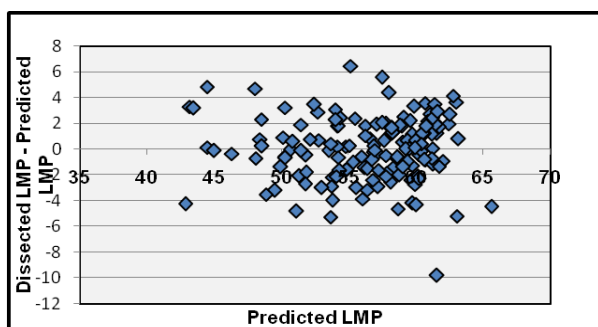


Fig 6. Residuals versus predicted lean meat percentage (LMP) for OGP

CONCLUSIONS

Romanian authorities applied for the authorization of the Fat-O-Meat'er and OptiGrade-PRO, on the basis of the results presented. The predictions formulas were applied to pig carcasses weighing between 50 and 120 kg hot weight.

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