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ROTHAMSTED EXPERIMENTS.

(Continued)

Recalculations—Abstract of expts. on pigs—⅔ of fat must have come from carbohydrates.

We have, however, as already said, long ago recalculated many of our feeding experiments, making allowance as far as practicable for the probable amount of indigestible and necessarily effete matters of the foods. We have also, as referred to at pages 252-255, arranged tables founded on our direct analytical results on the ten animals, showing the probable average percentage composition of the different descriptions of animal, each at eight gradationary points from the store to the very fat condition, and have applied the factors thus obtained, not only for the calculation of the composition of the increase in a number of cases of ordinary practice, and of direct experiment, but also for the recalculation of some of the results to which Table 70 relates. Accordingly, in the next table (71) are given the results obtained in experiment No. 1, which were inconclusive according to the original mode of calculation, and also those obtained in experiments 4 and 5, which, even as originally calculated, could leave no doubt of very considerable formation of fat from the carbohydrates.

All these recalculations are in the first place based on the assumption, since generally adopted by others, that 100 nitrogenous substance can at the most yield 51.4 of fat, instead of nearly 62, according to the original plan of calculation as adopted in the construction of Table 70. Then, each experiment is now calculated three ways: First, on the assumption that the whole of the fatty matter and nitrogenous substance of the food were digested; secondly, supposing that only 90 per cent, and thirdly, that only 80 per cent was digestible and available. Lastly, in the case of experiments 4 and 5, I have, after very carefully considering the weights and character of the animals and the duration of the fattening period, taken the initial and final composition, not as in Table 70 the same as in experiment 1, but the initial at a composition three-eights in advance from the store to the fat condition, as in experiment 1, and the final composition at one-fourth in advance of fatness, compared with the fat pig of experiment 1. It is worthy of remark that this carefully reconsidered independent mode of estimate gives almost precisely the same percentage of nitrogenous substance, and precisely the same of fat, in the increase in experiment 4 as in the former estimate, namely, 5·4 instead of 5.3 per cent of nitrogenous substance, and in both cases 79 per cent of at, the animals being all very fat. Again, the new mode of calculation gives for experiment 5, 6.4 per cent of nitrogenous substance, and 72.3 per cent of fat in the increase, instead of 6.5 and 71 per cent, as formerly adopted.

Let us first just refer to the results of experiment 1, in which parallel animals were analyzed, but in which, as has been pointed out, the food was much more highly nitrogenous than is appropriate in the fattening food of the pig. Those given in column 1, in which it is assumed that the whole, both of the nitrogenous substance and of the food, was digestible and available, show that when we now reckon only 51.4 instead of about 62 parts of fat to be derivable from 100 nitrogenous substance, even this experiment indicates that the fat in the food and that derivable from the nitrogenous substance consumed, were scarcely sufficient to cover the whole of the fat of the increase. Obviously, too, if it be assumed, according to the more recent estimate, that only about 42 parts of fat can be derived from 100 of albuminoid substance, there would then, even in this experiment with such abnormally high nitrogenous food, be a considerable formation of fat from carbohydrates.

Turning to the results in the second column, which are calculated on the assumption that only 90 per cent of the nitrogenous substance and fatty matter of the food would be digested, it is seen that, for 100 increase in live weight, 6.8 parts, for 100 total fat in the increase 10.8 parts, or for 100 newly-formed fat 13.9 parts, must have been derived from carbohydrates.

Lastly, in regard to experiment 1, reckoning only 80 per cent of the nitrogenous substance and fat of the food to have been digested and available, the result would be that 13·5 out of 63.1 parts of fat in 100 of increase, must have had some other source than fat and nitrogenous substance of food; or reckoned for 100 total fat in the increase, 21·4 parts, or for 100 newly-formed fat, 26.7 parts, must have been derived from carbohydrates.

In regard to the alternative assumptions that only 90 or only 80 per cent of the nitrogenous and fatty matters of the food were digested, it may be stated that in Wolff's tables, published in Mentzel und v. Lengerke's landwirthschaftlicher Kalender for 1890, he reckons 88 per cent of the nitrogenous substance of beans, 89.9 per cent of that of lentils, 77.9 per cent of that of bran, 79.2 per cent of that of maize, and 77 per cent of that of barley, to be, on the average, digested; and of the fatty matter of these foods he reckons 87.5 per cent of that of beans, 84.6 per cent of that of lentils, 70.6 per cent of that of bran, 85.1 per cent of that maize, but the whole, or 100 per cent of that of barley, to be digestible. So far, therefore, as experiment 1 is concerned, according to Wolff's factors, the truth would lie somewhere between the results supposing 90 and those supposing 80 per cent digested.

Even in this experiment then (No. 1), there is clear evidence of the formation of fat from the carbohydrates, when deduction is made for indigestible nitrogenous and fatty matters consumed, and when it is reckoned that only 51.4 parts of fat may be produced from 100 albuminoid substance. Obviously, if only 42 parts of fat as assumed by some, can be formed from 100 albumin, the evidence is clearer still.

Turning now to experiment 4, in which the food was maize meal alone, given *ad libitum*, and the relation of nonnitrogenous to 1 of nitrogenous substance was much higher than in experiment 1, and much more appropriate for the rapid fattening of the pig, the results are much more decisive. They were, indeed, quite conclusive as ori-

TABLE 71.—Sources of the fat of the animal body. Abstract of results of experiments made at Rothamsted with pigs. (Results reckoning 100 nitrogenous substance *in food may yield 51.4 fat.*)

	Experiment 1—Bean meal, lentil meal and bran, each 1 part; barley, meal, 3 parts.			Experiment 4—Maize meal ad libitum.			Experiment 5—Barley meal ad libitum.		
Proportion of nitrogenous substance and fat digested	All.	90p ct	80p ct.	All.	80p.ct	80p.ct.	All.	90p.ct.	80p.ct.
Albuminoid ratio (1)	3.8	3.8	3.8	7.3	7.3	7.3	6.3	6.3	6.3
For 100 increase in live weight.									
Nitrogenous substance:									
In food.....	100	90	80	57	51.3	45.6	64	57.6	51.2
In increase	7.8	7.8	7.8	5.4	5.4	5.4	6.4	6.4	6.4
Available for fat formation.....	92.2	82.2	72.2	51.6	45.9	40.2	57.6	51.2	44.8
Fat:									
In increase.....	63.1	63.1	63.1	79	79	79	72.3	72.3	72.3
In food.....	15.6	14	12.5	26.3	23.7	21	12.4	11.2	9.9
Newly formed.....	47.5	49.1	50.6	52.7	55.3	58	59.9	61.1	62.4
Derivable from nitrogenous substance. ...	47.4	42.3	37.1	26.5	23.6	20.7	29.6	26.3	23
From carbohydrates	.1	6.8	13.5	26.2	31.7	37.3	30.3	34.8	39.4
For 100 total fat in increase.									
Fat:									
From fat in food.....	24.7	22.2	19.8	33.3	30	26.6	17.2	15.5	13.7
Derivable from nitrogenous substance.....	75.1	67	58.8	33.5	29.9	26.2	40.9	36.4	31.8
Derivable from carbohydrates	.2	10.8	21.4	33.2	40.1	47.2	41.9	48.1	54.5
For 100 newly-formed fat.									
Fat:									
Derivable from nitrogenous substance. ...	99.8	86.1	73.3	50.3	42.7	35.7	49.4	43	36.9
Derivable from carbohydrates	.2	13.9	26.7	49.7	57.3	64.3	50.6	57	63.1

(1) In the calculation of these ratios the nitrogen is, as in Table 70, multiplied by 6.3 to represent total nitrogenous substance, and for column 1 of each experiment no deduction is made. For all three columns of each experiment the crude fat is multiplied by 2.4 to bring it into its equivalent of starch. For column 1 the amount of nitrogenous substance, not fat, is taken without deduction; but for columns 2 and 3, as in the case of the nitrogenous substance and the fat, only 90 or 80 per cent respectively of the total is assumed to be digested.