



Original Contribution

ATTEMPTS FOR OPTIMISATION OF FOIE GRAS AND MEAT PRODUCTION FROM MULARD DRAKES

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ABSTRACT

The experiment was conducted in 2014/2015 under the production conditions at a working mulard duck fattening farm and comprised 77 578 birds. The slaughter analysis was performed in a certified slaughterhouse with 74 945 mulard drakes. The pre-force stage and fattening stage were shortened – 63 and 11 days, respectively.

The overall death rate for the entire production period was 3.41% - 2.68±0.09% during the pre-force stage and 0.73±0.01% during the fattening stage. The mean live weight of birds at 63 days of age was 4.01±0.07 kg, and by the end of the 11-day fattening period: 6.58 kg on the average. The mean feed intake per bird was 11.94 kg during the pre-force period with FCR of 2.98. During the 11-day fattening period, mean corn intake was 9.180 kg/bird, and feed conversion ratio for the period was 3.56 kg.

The mean grill weight was 3.27 kg, corresponding to 49.6% slaughter yield. Mean liver weight was 0.57±0.008 kg, e.g. 8.6% of live weight. The produced foie gras was of excellent quality, mainly class A. The average magret weight was 0.760±0,008 kg comprising 23.26% of grill weight.

Key words: foie gras, mulard duck, pre-force stage, force-feeding, gavage.

INTRODUCTION

The first data about force-feeding of ducks for meat and foie gras production date back to ancient Egypt – more than 5000 years ago (1-3). Force-feeding was done manually, and at a later stage – by means of an improvised feeding tube.

Long after that, in XIV-XVI century, West European gastronomers have paid attention to culinary properties of foie gras including it in some renowned culinary books (4, 5). In XVII-XVIII century, meals with foie gras became popular among the upper class of France. By that time, foie gras was associated to the French cuisine and culture. During the XVIII century, Frenchmen changes geese gavage technology replacing millet with corn. The term foie gras is also of French origin and means fatty liver. The tradition in fattening waterfowl is preserved to present days with small exceptions regarding the type of corn: cooked grain or ground corn meal. The French legislation stipulates that foie gras is a product

of ducks or geese force-fed with corn which belongs to the protected cultural and gastronomic heritage of France (6).

The global foie gras production is concentrated in Europe, primarily in 5 EC member states. France is the biggest producer and consumer of foie gras in the world.

During the last 2 decades, mulard ducks have been imposed as the main hybrid for foie gras production over domestic geese due to several reasons. The production costs of a mulard duckling is substantially lower than that of a day-old gosling. Mulard ducks have a shorter pre-force rearing period as did geese. They have well-developed crops permitting a single feeding during the force-feeding period, sufficient for the next 10-12 hours. The final result – the product, has similar taste quality. The share of meat produced from mulard ducks is higher, and it belongs to the group of red game meat, hence it is highly sought after and appreciated.

The main products from mulard ducks are the foie gras and breast meat. Together they make up the main earnings from one bird – about 45-50%. Depending on the weight, colour, consistency and other quality traits, foie gras is

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classified into three classes: A, B and C. According to Petrov and Gerzilov (7), one kilogram of foie gras contains about 23–25 MJ energy, 6–8 % crude protein and 57–60 % fat, mainly triglycerides (with largest proportions of oleic: 56–68 % and palmitic fatty acids: 23–36 %). The most valuable parts of the duck carcass are the magret (the superficial pectoral muscle with the skin and subcutaneous fat), the bon-fillet (the deep pectoral muscle) and the leg. Magret constitutes about 30 % of earnings per birds.

The grower stage continues up to 2-3 months of age. This is a rather vague period and the successful production could be largely predetermined from feeding. More intensively fed ducklings could attain the minimum body weight of 3.8-4.2 kg required by the hybrid producer for fattening, at an earlier age. Another alternative for more efficient production is the stage of assisted feeding (gavage) that lasts 11 to 14 days, and during that stage, birds consume 16.5-17 kg corn. Some gender-related differences also influence foie gras amount and quality. The shortening of pre-force and force-feeding period and the utilization of male mulard ducks for foie gras production could result in a more efficient production of this gourmet product. This could be beneficial for the development of this branch of European poultry farming and strengthen the position of the foie gras production countries (France, Bulgaria, Spain, Hungary and Belgium).

The aim of the present study was to investigate the possibilities for optimisation of foie gras production and meat from mulard ducks through implementation of shorter pre-force and fattening period and rearing in single sex groups.

MATERIAL AND METHODS

The goal of the study was solved in real production conditions encompassing the brooder, grower and finisher periods. The experiments were conducted in 2014/2015 in the production premises of ET “Shans 61 – Vasil Vasilev”, Dobrich region, General Toshevo municipality, Northeastern Bulgaria. The production characteristics were analysed over an entire economic year, with 16 batches with average number of 4,875 mulard ducks per batch. The total number of birds for the economic year was 77,578. The slaughter analysis was performed in a certified slaughterhouse with 74,945 birds. Experimental subjects at the start of the study were day-old Hytop 85 mulard drakes.

During the pre-force stage, the birds were reared on deep permanent litter. The force-feeding premise was equipped with cages as per animal welfare requirements. Each cage had water trough providing permanent access to drinking water. Four birds were housed per cage.

The technological parameters in the experimental design corresponded to norms of hybrid's technological documentation and the current legislation.

The pre-force stage (brooder and grower) was 63 days, and force-feeding period – 11 days. During the first week, feed was offered in plastic trays with low edges. During the rest of the brooder and the entire gavage period, continuous feeding troughs were used. Optimum feeding width was provided according to the age category. Feed intake was controlled on the basis of daily consumption.

The nutritional content and pellet size of compounds feeds during the different sub - periods of the pre-force stage are presented in **Table 1**. During the fourth stage (gavage), only cooked corn was given. A conventional method comprising sieving for removal of impurities and cracked grain and boiling with hot water was used. Depending on the force-feeding stage, the corn was boiled for 40-60 minutes. Then the corn was poured into troughs for draining and cooling. It was supplemented with 3% fat and 0.5% vitamin mineral premix. During the fattening period, corn was given mechanically 2 times per day.

The experiment had the following stages:

➤ Production period. It could be divided into two sub-periods: pre-force and force-feeding.

The following traits were monitored during the pre-force period:

- Death rate (%). It was calculated on the basis of culled birds during the period;
- Final live weight (g) – determined by group weighing of birds during their transport to fattening premises;
- Total feed intake during the experimental period (g) – determined on the basis of results from feed intake for the period.
- Feed conversion ratio (kg/kg) – calculated on the basis of total feed expenditure and final live weight.

Fattening period. The following traits were monitored:

- Final liver weight (g). It was determined at the time of removal of mulard ducks from cages prior to slaughtering.
 - Death rate (%). It was calculated on the basis of culled birds during the period;
 - Corn consumption (kg/bird). The amount of corn consumed by each duck was calculated on the basis of data for feed expenditure, death rate and the number of fattening birds.
- Slaughter analysis. After cutting of duck carcasses, some important slaughter traits

were evaluated: slaughter yield, liver weight, magret weight, bon-fillet weight, edible offal weight, leg weight and wing weight. The relative proportion of each cut vs dressed carcass was calculated, as well as the proportion of edible offal from liver weight.

All data were analysed by Statistica 13.0 software (Statistica for Windows; Stat – Soft, 2015). Mean (\bar{x}), standard error of mean (SEM) and coefficient of variation (CV,%) values were calculated for each group.

Table 1. Nutritional composition of feed for the different stages of the pre-force stage.

Parameters	Feeding phase			
		Starter	Grower	Finisher
	Age, days	1-28	28-50	50>
Metabolizable energy (ME)	Kcal/kg	2894.56	2890.82	2856.76
Crude Protein	g/kg	191.89	164.76	160.40
Crude fat	g/kg	24.68	25.64	25.33
Crude fiber	g/kg	41.61	49.09	51.86
Calcium	g/kg	10.54	9.43	8.89
Available phosphorus	g/kg	5.81	5.16	5.04
Digestible Lisine	g/kg	10.27	9.15	8.41
Digestible Methionine	g/kg	5.71	4.79	4.24
Dietary electrolyte balance	mEq/kg	225.65	200.47	194.92
Pellet size	mm	2-3/4-6	4-5/8-10	4-5/8-10

RESULTS

Throughout the study period, mean death rate in the 16 batches was $2.68 \pm 0.09\%$. This rate was within the normal range associated to mulard duck rearing. Favourable death rate could be attributed from one part to the use of male ducklings and from the other, to provided appropriate conditions of feeding and rearing.

Figure 1 presents data for the average live weight of ducks at day 63 when they were transferred

in the fattening premises. The final live weight of the 75,496 birds for the studied year was 4.01 ± 0.07 kg. Coefficient of variation was 7.4%. The lowest average live weight was determined for summer batches (3.71 ± 0.06 kg), and the highest – in winter batches (4.28 ± 0.14 kg). The batches reared in the autumn and spring had average final weights of 3.93 ± 0.07 and 4.04 ± 0.09 kg respectively.



Figure 1. Average live weight of the different batches during the pre-force period.

During the pre-force period, mean feed intake per bird was 11.94 kg. Depending on the results about final live weight and feed intake, feed conversion ratio for the 63-day pre-force period was 2.98 kg/kg.

At the end of the force-feeding, the average live weight of the 74,945 mulard drakes was 6.58 kg.

Figure 2 presents force-feeding death rates by batches. The average death rate during the gavage period was $0.73 \pm 0.01\%$ for the study period. From all 75,496 birds at 63 days of age, 74,945 74-day-old birds were sent to the slaughterhouse. The overall death rate over the entire study period (pre-force and force-feeding) of all 16 batches of mulard drakes was 3.41 %.

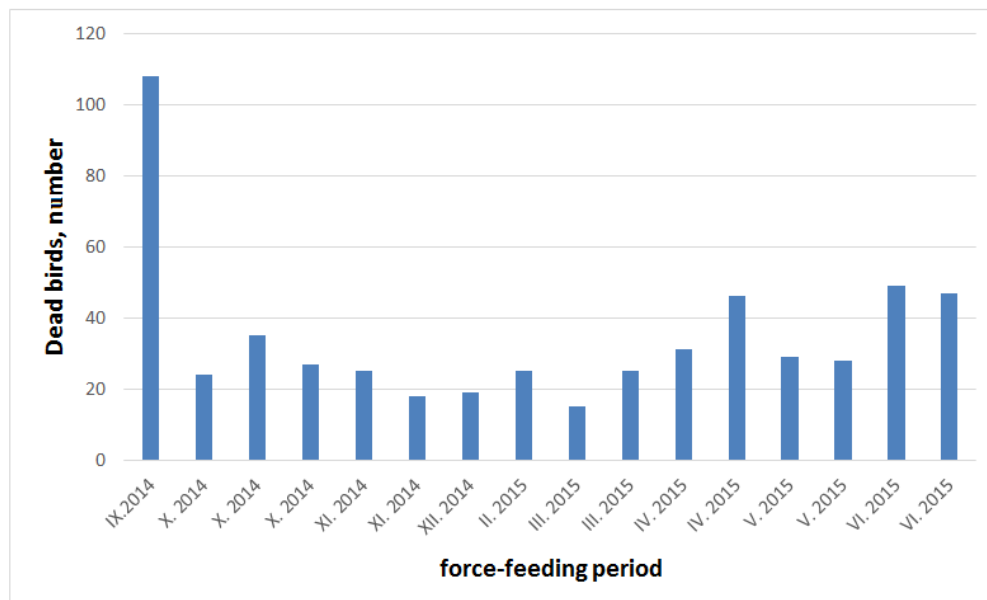


Figure 2. Dynamics of force-feeding death rates by batches.

With respect to the average corn consumption per bird over the 11-day fattening period, the results were very good – 9.18 kg per bird. Calculated with respect to foie gras, 100 g foie gras was produced from 1.61 kg corn. Feed conversion during that period was 3.56 kg.

Table 2 presents data from the slaughter analysis of mulard drakes. A total number of 74,945 birds from all 16 batches were slaughtered. The average grill weight (carcass without visceral organs, neck, legs and feathers) was 3.267 kg, which corresponded to a slaughter yield of 49.6%.

Table 2. Slaughter analysis of mulard drakes.

Parameters	weight, kg	%	Parameters	weight, kg	%
Grill/slaughter yield	3.267	49.63	Meat slice*	0.024	0.73
Liver	0.569	8.64	Neck	0.159	2.42
Magret*	0.76	23.26	Back*	0.891	27.27
Bon-fillet (M.p.p.)*	0.068	2.08	Wing*	0.181	5.54
Leg*	0.794	24.30	Drumette*	0.268	8.20
Gizzard	0.046	0.70	Heart	0.03	0.46
Fat slice *	0.253	7.74	Abdominal fat	0.109	1.66

* Equivalent to the carcass weight.

M.p.p. – *Musculus pectoralis profundus*.

The most valuable product from fattened waterfowl is the liver. In the current production conditions, average liver weight was 0.57 ± 0.01 kg, comprising 8.6% of the liver weight of the bird. The produced liver was of excellent

quality, mainly from class A. **Figure 3** presents data for the dynamics of produced foie gras and magret over the economic year. No significant differences were noted among

the batches with regard to foie gras (CV=5.8%).

Magret is the second main product from fattened ducks. In our experiment, average magret weight was 0.760 ± 0.008 kg, e.g. 23.26% of grill weight. There were only slight variations among the batches over the studied period (CV=4.43%; **Figure 3**). The highest magret weight (0.816 g) was observed in the

batch fattened in April 2015. The worse results were obtained in batches fattening during the hot months: June and September – 0.734 and 0.677 kg, respectively.

Regardless of the relatively small share of bon-fillet (about 2% of grill weight) it is a high-quality and expensive product. Another valuable duck carcass cut is the leg. Its average weight was 0.794 kg or 24.3% of grill weight.

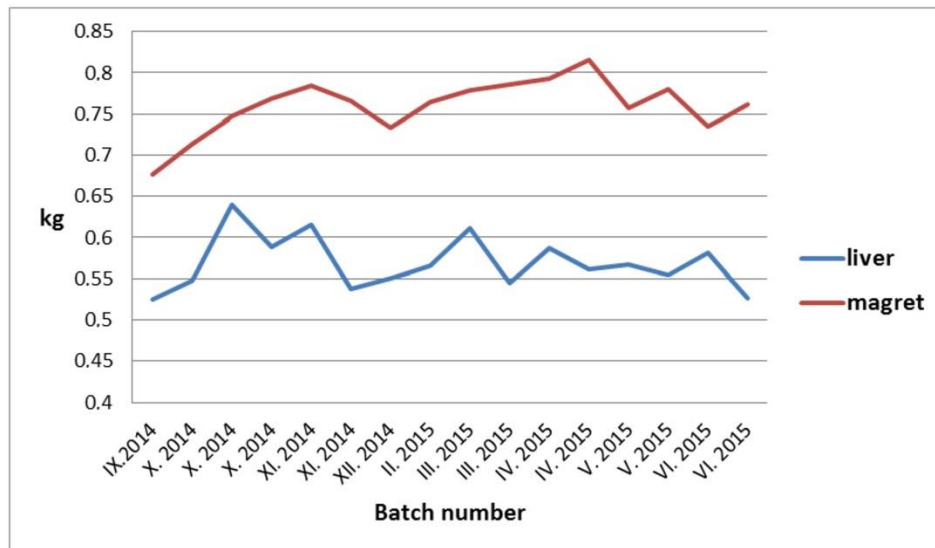


Figure 3. Dynamics of produced foie gras and magret over the economic year.

DISCUSSION

Usually, the pre-force period is characterized with higher death rate than the force-feeding period. The most critical moments during the pre-force period are:

- The beginning (the first 7-14 days of age),
- The period of intensive feather growth characterized with frequent occurrence of feather pecking (about 21-28 days of age)
- Traumatic injuries when birds are caught for transfer into fattening premises.

Using high-quality day-old mulard drakes and offering complete easily accessible fodder, appropriate prophylaxis programme and optimal microclimate provides low death rates during the first two weeks of life. The implementation of debeaking prevents the manifestation of cannibalism during the so-called extensive pecking crisis (8). Our data corresponded to data reported by Petrov (3) about pre-force death rates in mulard drakes of Grimaud Frères Sélection. The author demonstrated considerably higher death rates in Bréheret drakes. In our studies, the highest death rate occurred in batches reared during the summer and autumn, when ambient temperatures were high.

The lower performance for the average live weight of ducks at day 63 during the summer period could be attributed to the unfavourable

climatic conditions and the difficulties in maintaining optimal microclimatic parameters in premises and high ambient temperatures in the yards. On the other hand, the environmental conditions acted as stressors for birds through reduction of feed intake and higher energy expenditure for maintenance of vital functions. The early autumn is also characterised with high ambient temperatures

and a similar effect was observed. The lower performance during the spring could be explained by the increased outdoor and indoor humidity as well as the lower quality of feed (grain ingredients). Similar results with regard to the seasonal influence on pre-force live weight were reported by Petrov (3). Our data were superior to weights indicated in the technological documentation of the used hybrid (3.93 kg at 63 days of age). This live weight was within the optimum range recommended for beginning of force-feeding and guarantees a high-quality produce. Wawro *et al.* (9) reported final male mullards body weight of 3.150 kg at 12 weeks of age. Salichon *et al.* (10) and Beaza (11) reported

4200±356 g and 4622±314 g live weight at the same age for male mallard ducks respectively. Feed conversion ratio for the 63-day pre-force period is compatible to FCR outlined by hybrid producer in the technological documentation for the respective period (FCR = 2.9). As the pre-force period duration increased, FCR for Hytop 85 hybrids increased to attain 3.61 at 84 days of age according to data provided by Grimaud Frères Sélection. This marked difference in feed conversion and the body “maturity” of 63-day-old fattening ducks allowed affirming that the shorter pre-force period was appropriate and economically justified for mulard ducks rearing. The difference in the total feed consumed by one birds until 63 days of age and 84 days of age was 3.6 kg on the average. This feed saving is associated to the fattening period.

For the short 11-day gavage period, the birds’ live weight increased by 2.58 kg on the average, and the primary part of this weight gain was due to fat deposition in subcutaneous and abdominal adipose depots, as well as to intramuscular fat. Throughout this period, the liver size increased up to 10 times due to fatty infiltration (2). The growth also continued during that time. At the end of the force-feeding period, the birds exhibited pale beaks, abdominal type of breathing, with undigested corn grains in faeces, faecal staining of the abdominal region etc..

The death rate during the force-feeding period was lower vs the pre-force period. It is mainly due to traumatic injuries during the gavage and problems related to fattening. As seen from the figure, death rate in the batch set in September 2014 was markedly increased. This could be attributed to the high ambient temperature and subjective factors associated to the personnel performing the gavage. The superior results with respect to death rates were obtained in batched fattening in the autumn. If the results about the first batch are omitted, the average death rates in the other batches were similar. Our data were in line with desired values and difficult to be achieved for many producers.

Similar although slightly higher slaughter yields in male ducks under normal duration of the pre-force period were reported by Auvergne, 1992 (cited by 12) and Petrov (3): 55.9% and 53.61% respectively. Petrov (3) provided evidence for increased liver weight during the force-feeding period by 47.9%, whereas in the present study the increase was by 64.5%. The final live weight in the cited investigation was by 0.323 kg than our data. A

comparable final live weight in mule ducks force-fed for 14 days at 14 weeks of age was reported by Salichon *et al.* (10), Beaza *et al.* (11) and Chartrin *et al.*, 2006 (cited by 13) were 6.47 ± 0.46 kg, 6.49 ± 0.3 kg and 6.47 ± 0.35 kg respectively. This confirmed the possibility for compensation of the delay with respect to this trait when the pre-force period was shorter.

Our results for average liver weight agreed with those reported by Beaza (12), Beaza *et al.* (11), Petrov (3) and the producer of the hybrid when 84-day pre-force period was followed or slightly lower than those reported by Salichon *et al.* (10) and Guy *et al.* (14). Chartrin *et al.*, 2006 (cited by 13) indicated a considerably lower liver weight in mulard drakes force-fed over 14 days and slaughter at 14 weeks of age – 494 ± 97 g.

Our results with respect to magret weight were similar although slightly lower than those reported by Guy *et al.* (14) and Petrov (3) under the condition of standard pre-force and force-feeding period. The data provided by the hybrid producer were comparable to our results. The results obtained for bon-fillet weight were similar to those of Petrov (3). Similar but somewhat higher leg weights were reported by the same author (3) in Grimaud Frères Sélection fattened mule drakes (865±20.20 g).

Table 3 shows that the shorter pre-force period (by 21 days) and the shorter force-feeding (by 3-4 days) could result in more optimal foie gras production. This way, instead of 3.72 batches per year, one pre-force premise could produce by 26.9% more birds. This increases the efficacy of utilisation of available facilities. In both variants, there were no problems with gavage facilities loading, as the period of their population and the sanitary period were substantially shorter. There were small differences in favour of the traditional technology as slaughter traits were concerned, in particular, higher foie gras and magret yields (by 5.2% and 1.3% respectively). Along with some basic economic traits such as FCR during both pre-force and force-feeding periods, and the higher turnover rate of batches, the improved technology exhibits some serious advantages. The quality of the produce is standard (premium) and was compliant with the producers’ norms. The amount is close to the potential of the hybrid, but the costs of produce are lower which presents a greater versatility in the production of these gourmet products.

The optimisation of mulard duck production is an important step for every producer in order to be competitive and to manage a profitable and sustainable production. The

implementation of a shorter pre-force and force-feeding periods and the use of male mulard ducks are serious benefits with this regard.

Table 3. Comparison between experimental results and the Hytop 85 manufacturer data.

Parameters	Our results	Manufacturer data	Difference
Feed consumption, kg per bird	11.937	15.910	-24.9%
FCR, kg/kg	2.98	3.7	-19.46%
FCR, kg corn / 100 g foie gras	1.61	1.7-1.9	-10.55%
Liver, kg per bird	0.569	0.6	-5.2%
Magret, kg per bird	0.76	0.77	-1.3%
Pre-force period, days	63	84	<21 days
Force-feeding period, days	11	15	<4 days
Number Batches/year	4.74	3.72	+26.9%

CONCLUSION

The performed production experiment allows concluding that:

- The application of shorter pre-force period (63 days) in the rearing of male mulard ducks did not have any negative impact on the live weight in the beginning of the gavage period;
- Shorter pre-force and force-feeding periods of 63 and 11 days respectively, did not have significant effect on the final foie gras and magret weights as compared to those realised in production cycles of normal duration;
- Shorter production cycle for mulard drakes of a total of 74 days resulted in lower feed intake and superior feed conversion during the pre-force and force-feeding periods, hence lower production costs;
- The shorter pre-force periods shorter optimized the production of foie gras and duck cuts through increased production facilities turnover.
- Death rates during the pre-force and force-feeding periods in implemented production system did not differ from respective rates in traditional mulard ducks rearing.

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