



# First insight into genetic variation of fatty acids content in flesh of common carp, *Cyprinus carpio* L.

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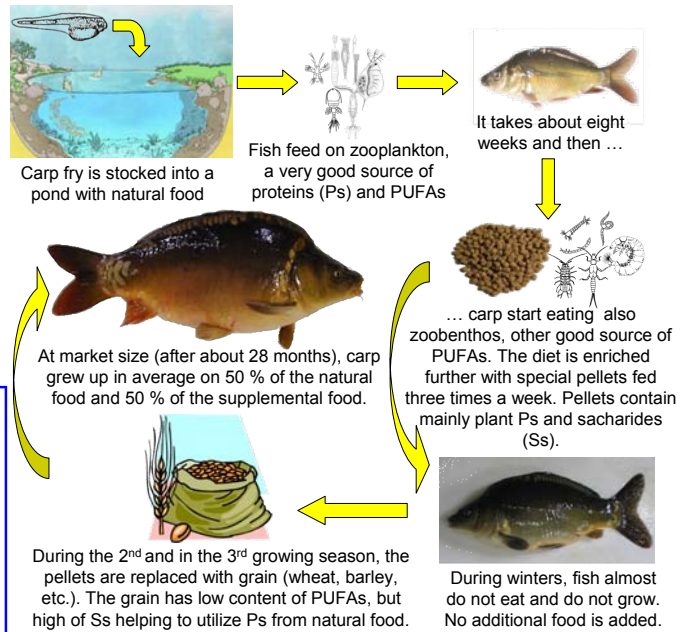
## Introduction and aim of the study

- Essential fatty acids (FAs), mainly polyunsaturated FAs (PUFAs), in food have a positive effect on human health. Hence, high attention has been devoted to improvement of FA content in flesh of farmed animals through nutrition.
- FA composition of animals is aside nutrition, as a main part of environmental factors, determined also by genetic factors where knowledge is poor.
- In fish, an important source of PUFAs for humans, information about genetic variation of FA content is totally missing.
- The aim of this study was to determine the genetic variation of FA content in common carp, a very important fish in freshwater aquaculture.

## Material and methods

- Fish for this study were taken from a stock established for purposes of an experimental breeding program.
- The stock arose by full-factorial cross (crossing each female with each male) of 8 females and 96 males using an artificial reproduction. All parents were genotyped for X microsatellites from fin tissue.
- Fish grew up under semi-intensive pond conditions till market size (1395 ± 273,4 g). Fish fed on natural and supplemental food (see Figure 1).
- At the market size, all survivors (336 fish) were slaughtered and fillets without skin were frozen. All fish were genotyped like their parents.
- Based on the parentage assignment, 158 individuals (being progeny of 7 females and 36 males) were selected for the FA content analysis.
- Total fat was analysed with Soxtec extraction system (Tecator, Sweden) and FA content using gas-liquid chromatography.
- Basic statistical parameters were calculated by STATISTICA software; genetic variations of traits were calculated by V.C.E. 6.0.2.

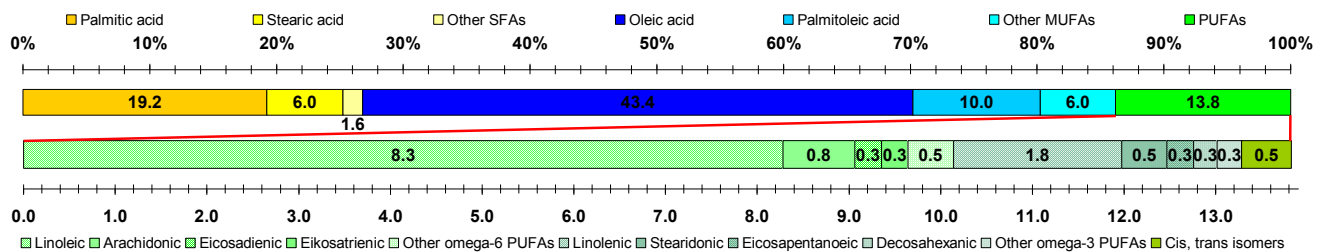
Figure 1: Typical producing cycle of common carp in the Czech Republic and during the present study



## Results

- Average value of total lipids in wet fillet was 3.2±1.92 % and surprisingly, the trait was not heritable ( $h^2=0.8\pm0.11$ ). Composition of fat is shown in Figure 2. Coefficient of variations (CVs) for single FAs ranged from 5.5 % in oleic acid to 105.6 % in lauric acid. High CVs were in FAs with very low relative content (<0.3 % of total fat); the average CV was 33.5 %.
- Heritabilities ( $h^2$ ) of selected FAs (in relative and absolute values) and PUFA groups ( $\omega-6$ ,  $\omega-3$ ,  $\omega-6/\omega-3$ ) calculated by single-trait animal model ranged from 0.0 to 0.30 and were not significantly different from zero.

Figure 2: Average % FA content in fat of common carp in present study. Upper line shows main FA groups with single FAs of the highest content: saturated FAs (SFAs) – yellow hues; monounsaturated FAs (MUFAs) – blue hues. Composition of PUFAs (green colour) is shown in detail in the lower line. Bright green motifs represents  $\omega-6$  PUFAs, dark green are  $\omega-3$  PUFAs and khaki colour shows trans-cis isomers.



- However, when  $h^2$  for FA groups were estimated with multi-trait models, they were often significant and middle valued. In one model calculation, % total fat in wet fillet was also heritable (Table 1). Genetic (G) and phenotypic (Ph) correlations between traits were in most calculations similar (Table 1).

Table 1: Estimates of  $h^2$  (yellow), G (green) and Ph (blue) correlations of selected traits in common carp from a multi-trait model. TF-M: % of total fat in wet muscle tissue; - TF: relative values (in % of total fat); -M: absolute values (in % of wet muscle tissue)

Trait	Weight	TF-M	SFA-TF	MUFA-TF	PUFA-TF	SFA-M	MUFA-M	PUFA-M
Weight	0.63±0.16	0.47±0.14	0.43±0.19	0.24±0.19	-0.56±0.14	0.5±0.13	0.45±0.13	0.47±0.17
TF-M	0.05	0.24±0.04	0.62±0.13	0.58±0.16	-0.98±0.06	1.00±0.00	1.00±0.01	0.98±0.03
SFA-TF	0.08	0.06	0.26±0.08	-0.26±0.22	-0.73±0.11	0.68±0.12	0.60±0.14	0.58±0.21
MUFA-TF	0.01	0.33	-0.63	0.11±0.05	-0.47±0.18	0.52±0.18	0.60±0.16	0.59±0.17
PUFA-TF	-0.10	-0.48	-0.26	-0.59	0.34±0.09	-0.99±0.04	-0.97±0.05	-0.94±0.18
SFA-M	0.07	0.99	0.18	0.26	-0.50	0.28±0.04	0.99±0.00	0.97±0.04
MUFA-M	0.05	1.00	0.02	0.38	-0.50	0.98	0.23±0.04	0.97±0.03
PUFA-M	0.03	0.98	0.01	0.26	-0.34	0.96	0.97	0.17±0.05

- Significant heritability (0.34±0.13) was observed for relative content of eicosapentaenoic acid (EPA), a highly health-valued PUFA. High and positive genetic correlation ( $r=0.74$ ) was observed between EPA and docosahexaenoic acid (DHA) content, although heritability of DHA content was insignificant (0.05±0.06). Unfortunately, in absolute values (in % of wet muscle tissue) neither EPA nor DHA were heritable.

## Conclusions

- It seems that there is a significant genetic variation in FA content of common carp flesh.
- Relative content of PUFAs in total fat might be increased by selection on lower fat content.
- Unfortunately, fat content in this study was not heritable in most calculations. If we considered it is heritable (Table 1), selection for lower total fat would lead to decrease of fish growth.
- Taking into account the FA composition of natural and supplemental food, it seems that faster growing fish ate higher rate of grain when compared to total food intake.
- Thus, selection program for FA content in semi-intensive pond culture would not be reasonable without changing the strategy of supplemental feeding.

## Acknowledgement

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