

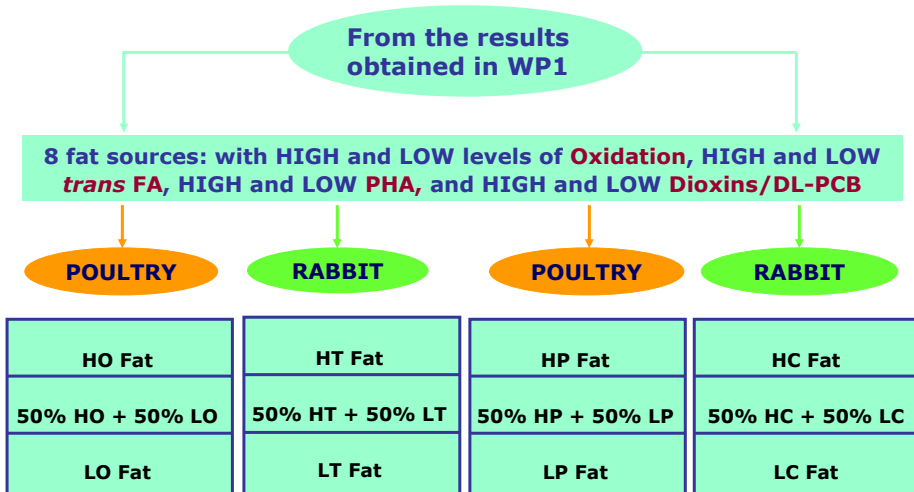


"Quality and safety of feeding fats obtained from co-products and by-products from the food chain"

RESULTS ON LIPID COMPOSITION AND OXIDATION IN ANIMAL SAMPLES

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EXPERIMENTAL DESIGN, common to WP2,3 & 4



4 TRIALS x 3 treatments x 8 replicates = 4 x 24 = TOTAL 96 samples RABBIT
TOTAL 96 samples POULTRY
96 samples of MEAT - 96 samples of LIVER - 96 samples of PLASMA (+ faeces or urine)

O = oxidation level T = *trans* FA isomers P = PAH C = dioxins & PCB

Fats added to experimental feeds

Criteria for selection: *Values in the range observed for fats in WP1

*Similar FA composition (if possible) inside each trial

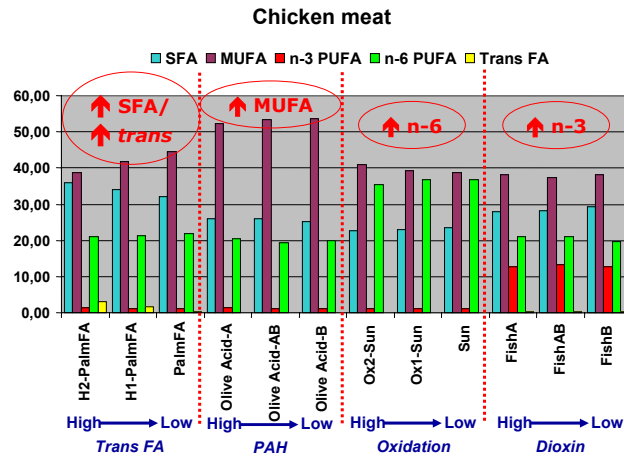
*Similar in another factors that could interfere (contaminants ...)

<i>Trial</i>	<i>Level</i>	<i>Fat</i>	<i>Code</i>
Trans	Low	Palm fatty acid distillate	PalmFA
	High	Hydrogenated palm fatty acid distillate	H2-PalmFA
PAH	Low	Acid oil from chemical refining of olive oil	Olive Acid-B
	High	Acid oil from chemical refining of pomace olive oil	Olive Acid-A
Oxidation	Low	Sunflower-olive oil (70:30, v/v)	Sun
	High	Sunflower-olive oil (70:30, v/v), after commercial frying process	Ox2-Sun
Dioxin	Low	Fish oil	Fish-B
	High	Fish oil	Fish-A

RESULTS

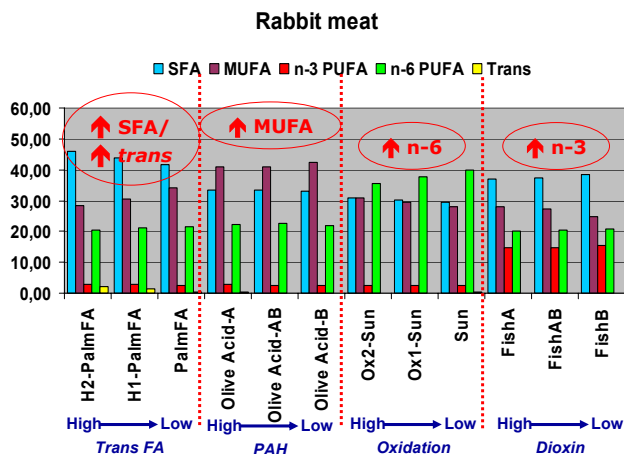
FA composition
Tocopherol and tocotrienol
content
Cholesterol content
Oxidation values

FA composition – CHICKEN MEAT (with skin)



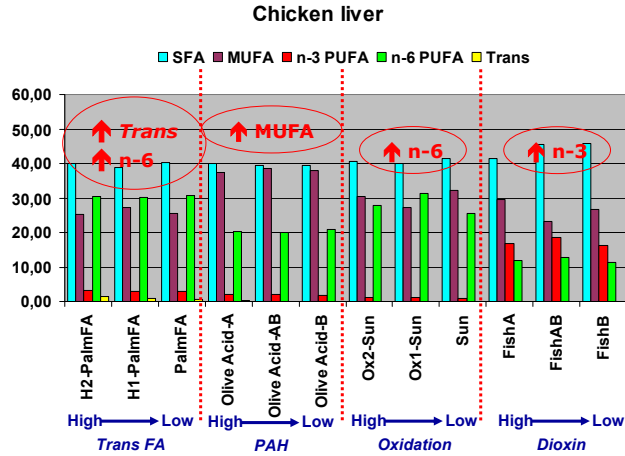
- In general, we can see that the chicken meat samples reflect the FA composition of the feeds, and of the fats added to the feeds.

FA composition – RABBIT MEAT



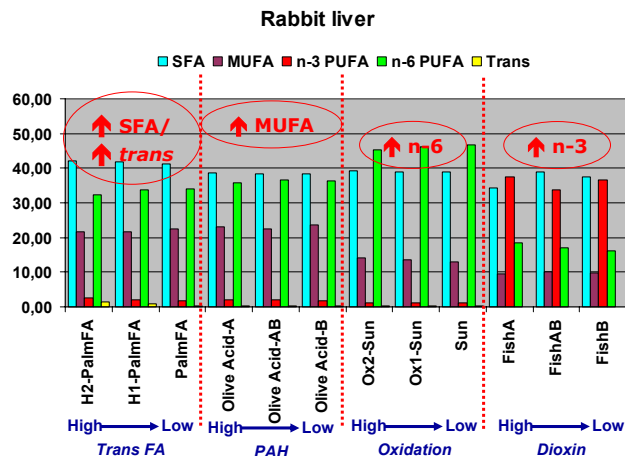
- As it was observed in chicken, the FA composition of the rabbit meat was influenced by the composition of the feeds and fats added to the feeds.
- However, in general, SFA are higher and MUFA lower than in chicken meat, particularly in meats coming from SFA and PUFA n-3 feeds.

FA composition – CHICKEN LIVER



- In general, we can see that the liver chicken samples do not reflect so well the FA composition of the feeds.
- SFA is predominant in all cases, and the highest values correspond to fish oils feeds.

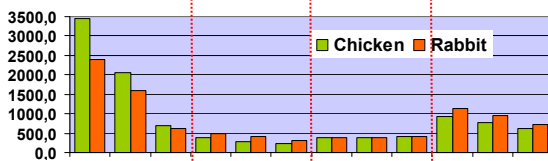
FA composition – RABBIT LIVER



- In general, we can see that the liver rabbit samples reflect better the FA composition of the feeds, and of the fats added to the feeds.
- SFA are not so predominant as in chicken liver, and the levels of deposit of PUFA n-6 (all cases) and n-3 (fish oil feeds) are much higher than in chicken liver and meat samples.

Trans FA & CLA – CHICKEN & RABBIT

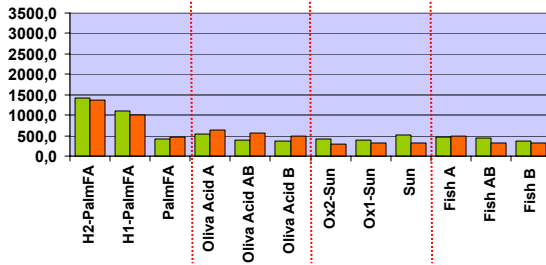
MEAT (mg/100g)



- Deposit in general related to the corresponding content in feeds. Obviously, only the meats from animals fed hydrogenated fats show high amounts

- Livers accumulate lower amounts of *trans* FA than the corresponding meats

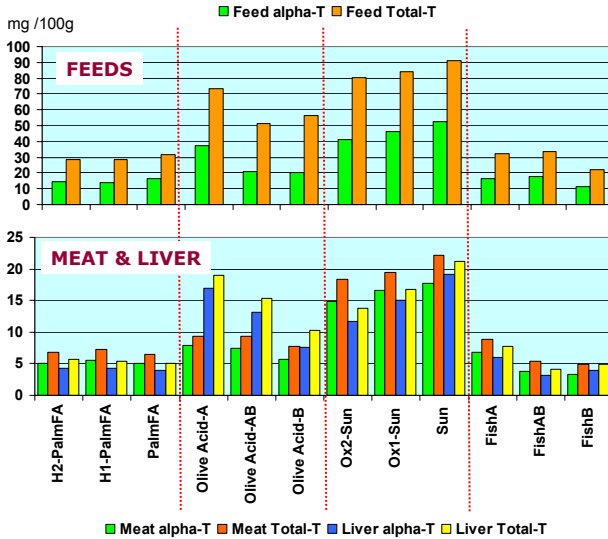
LIVER (mg/100g)



- The chicken shows higher ability to accumulate *trans* FA than the rabbit

- CLA isomers in rabbit and chicken meat and liver were absent, according to the non detectable levels found in the corresponding feeds.

Tocopherols – CHICKEN Meat & Liver

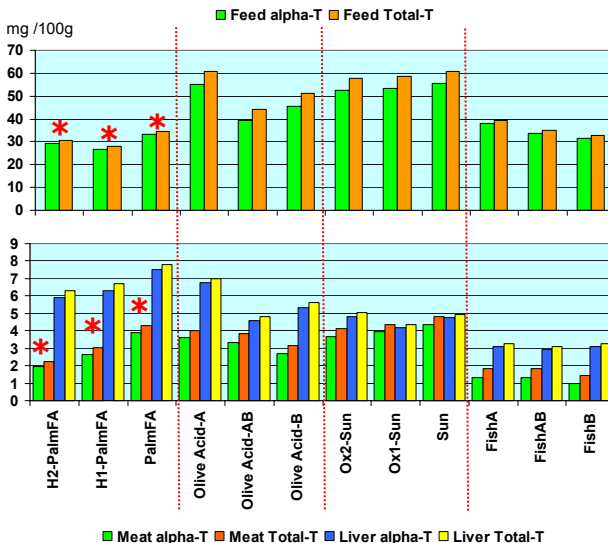


- Tocopherol deposit, in general, related to the corresponding content in feeds

- Similar profiles in Meat and Liver for SFA and PUFA n-3 feeds

- For MUFA feeds, tocopherol values are higher in Liver, while for PUFA n-6 feeds, tocopherol values are higher in Meat

Tocopherols – RABBIT Meat & Liver

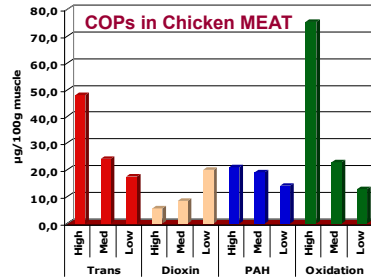
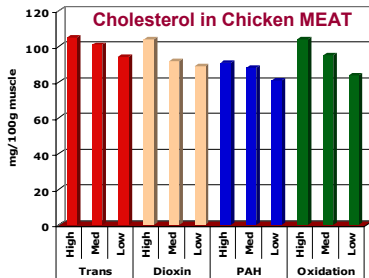
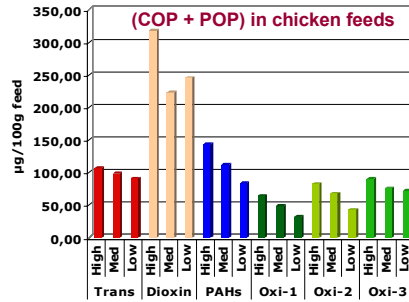
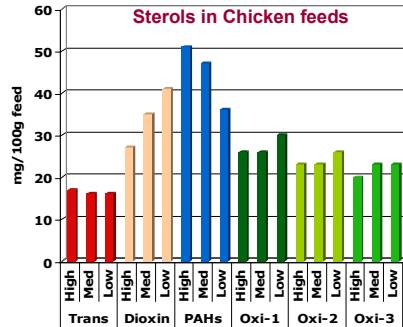


- Deposit of tocopherols in Meat is, in general, proportional to the feed content. However, these values are 1,5-4,5 fold lower for rabbit than for chicken.

- Particular effect was observed for very SFA feeds (deposit inversely correlated to %SFA)

- In contrast to that found in chicken, Liver tocopherol deposit is always higher than Meat one

Cholesterol & COP – CHICKEN MEAT



Cholesterol & COP – CHICKEN MEAT

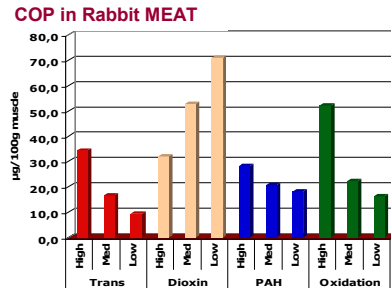
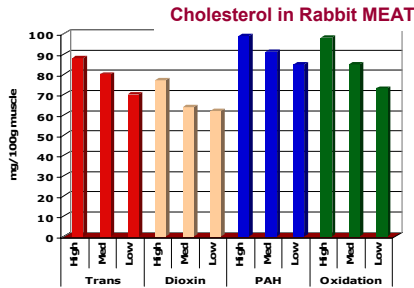
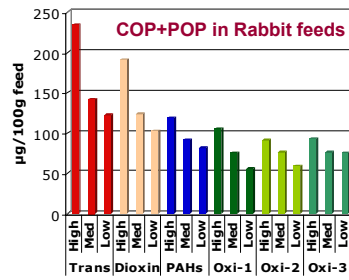
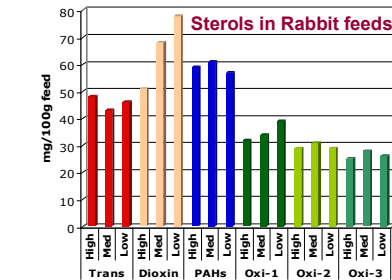
- The highest levels of Sterols were found in MUFA feeds and the lowest in SFA feeds. Usual levels of cholesterol in fish oil feeds.

- No differences were observed between the levels of COP in feeds, except the higher levels of COP found in fish oil feeds (probably because of the much higher oxidability of PUFA n-3).

- As it is expected, levels of cholesterol were very similar for all types of chicken meat.

- Regarding the formation of COP in chicken meats, values are very similar in general, except for meat coming from the feed containing the oxidated PUFA n-6 oil.

Cholesterol & COP – RABBIT MEAT

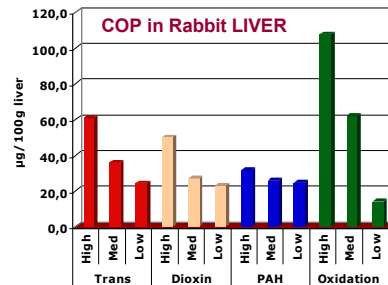
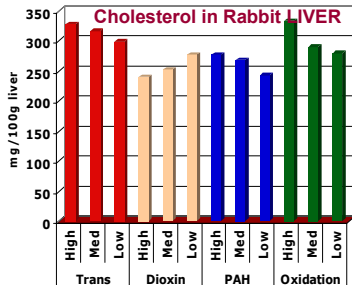
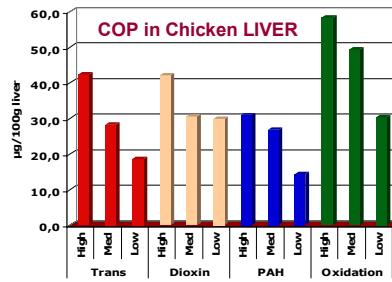
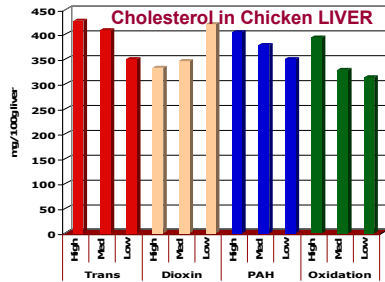


Cholesterol & COP – RABBIT MEAT

- **Tendencies and differences were very similar to those described for chicken.**

- **The only difference corresponded to the formation of COP in meats. In the case of rabbit meat the highest values corresponded to the meat coming from one of the fish oil feeds, instead of the oxidated PUFA n-6 feed.**

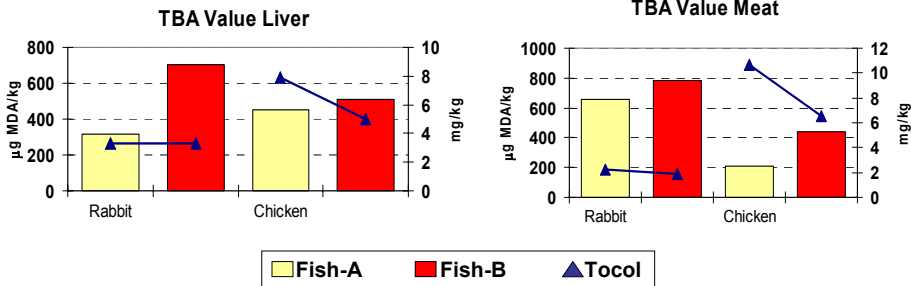
Cholesterol & COP – Chicken and Rabbit LIVER



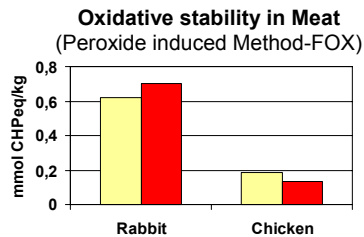
Cholesterol & COP – Chicken and Rabbit LIVER

- Very similar profiles of cholesterol and COP formation in the liver samples corresponding to chicken and rabbit.
- The highest COP values were observed for liver coming from fish oil feeds, and the lowest from MUFA feeds.
- The main quantitative difference, in general, was that cholesterol values were lower in rabbit liver, while COP values were higher for rabbit livers respect to chicken livers.

Oxidation parameters: Fish Oil feeds



OILS	Fish-A	Fish-B
PV, meq/kg	4,3	1,7
FOX, mmol CHPeq/kg	3,66	0,34
Polymer, % (w/w)	0,21	2,65
TBA, µg MDA/kg	65	2819
α-Tocopherol, mg/kg	86,72	56,55



Oxidation parameters: Fish Oil feeds

- Only the three treatments including fish oils showed high values for the oxidation parameters. The other nine feeds (including SFA, MUFA, PUFA n-6 and oxidated PUFA n-6) led to negligible oxidation values.

- Clear differences were found for the *TBA value* between meats and between livers coming from the two fish oil feeds.

- The level of tocopherol in the tissue seems to be a key factor, since *TBA value* are inversely correlated with this content. The big differences in the oxidation levels between both fish oils can also explain these *TBA value* differences in meat and livers.

- Oxidation levels in rabbit meat and liver were always higher than the corresponding levels in chicken samples. This can be explained also by the lower levels of tocopherols found in rabbit samples.

- Regarding the *oxidative stability*, differences between meats coming from both fish oil feeds are scarce. But, again, rabbit meat showed higher values than chicken meat samples.

MAIN CONCLUSIONS

- **The fatty acid composition of the feeding fats affect directly to the fatty acid composition of meat. In general, both profiles correlated well. However, rabbit meat tends to be more "saturated" than chicken meat.**
- **The fatty acid profile of the corresponding livers show differences respect to the meats. Chicken livers tend to deposit more SFA and rabbit livers more PUFA.**
- **Deposit of *trans*FA and CLA isomers is directly proportional to the content in the corresponding feeding fat.**
- **Tocopherol deposit in meat and liver is usually correlated with its content in the corresponding feed. However, the FA composition can modulate the rate of transfer (it increases with saturation, but very saturated fats reduced tocopherol deposit).**
- **Rabbit always shows higher tocopherol values for liver than for meat. Chicken shows the opposite pattern, except for MUFA feed fats.**
- **Cholesterol levels in meat and liver are not modifiable according to the feeding fat. Formation of Cholesterol Oxidation Products (COP) is favoured when oxidated or very polyunsaturated fats are added to the feed.**
- **Levels of oxidation is very low and oxidative stability high, both for chicken and rabbit, except when very polyunsaturated fats are used (i.e. fish oils). In this case, the level of oxidation and oxidability are mainly related to the tocopherol content in the tissue.**