



THE EFFECT OF THE REGULAR CONSUMPTION OF LARD FROM FATS OF CROSSBREED MANGALITSA AND BREED OF MEAT TYPE PIG ON THE LIPID PROFILE OF CONSUMERS

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ABSTRACT

The aim of this study was to evaluate the influence of consumption of lard processed from crossbreed of the original mangalitsa genotype and the breed of meat type pigs on selected biochemical parameters: total cholesterol (T-C), LDL cholesterol, HDL cholesterol and triacylglycerols (TAG). Twenty-nine probands participated in the study, of which 14 women and 15 men (aged 21 – 59) who consumed regularly lard four times a week during 5 weeks. By evaluating the lipid profile of probands, we observed elevated hypercholesterolemia at the beginning of the study in 43% women and 27% men. Statistically significant differences were recorded in this group of probands, where we recorded a decrease in TC of 0.55 mmol.L⁻¹ in the whole sample of probands with $p < 0.05$ probability in the 2nd sample of study after 5 weeks of consumption of lard. Borderline high (up to 3.35 mmol.L⁻¹) was found in 21% of women and 33% of men, and above LDL cholesterol was found in 79% of women and 60% of men. This high level of LDL cholesterol is considered a risk factor for the development of atherosclerosis. We can conclude from the results that regular consumption of lard has significantly reduced the total cholesterol levels, especially in women, this effect has been associated with lowering LDL cholesterol ($p < 0.01$) and lowering HDL cholesterol.

Keywords: lard; cholesterol; lipid profile; mangalitsa

INTRODUCTION

Dietary fatty acids play significant roles in the cause and prevention of cardiovascular disease (CVD). Trans fatty acids from partially hydrogenated vegetable oils have well-established adverse effects and should be eliminated from the human diet. CVD risk can be modestly reduced by decreasing saturated fatty acids (SFA) and replacing it by a combination of polyunsaturated fatty acids (PUFA) and mono-unsaturated fatty acids (MUFA) (Michas, 2014). The clinical consequences of atherosclerosis in the form of cardiovascular diseases still remain despite significant advances in treatment of the major causes of mortality in developed countries (Vohnout and Rašlová, 2009). Significant is the effect of fatty acids in the diet on blood lipoprotein levels (Béder et al., 2005).

Lard is considered as high-nutritional food that is part of human nutrition. It contains 40% of saturated and 59% unsaturated MK, of which 44% monounsaturated and 11% polyunsaturated fats have better ratio of omega 3 to omega 6 MK (Gunstone., 1996). It contains vitamin D, which helps in absorbing nutrients in the intestine, prevents rachitis and osteomalacia, help to absorb calcium which prevents osteoporosis and arthritis. Another important

vitamin in lard is tocopherol (Kasper, 2015). Lard is one of the most widely used raw materials of animal origin derived from fatty tissues of pigs. The fatty tissue includes the bacon and the internal saddle, which are grouped into qualitative classes used in the food industry or in the technical industry. Pig lipids are an important source of conjugated linoleic acid, which in the light of recent studies can provide protection against some civilization diseases (Nistor et al., 2012). From animal fats, lard has the highest thermal stability with a relatively high content of unsaturated fatty acids, especially oleic acid (Jurkovičová, 2005, Wollmannová et al., 2018).

According to the Statistical Office of the Slovak Republic (2016), the consumption of edible fats and oils per capita rose by 2.8%, compared to 2015 and amounted to 21.7 kg. With regard to recommended food doses (ODP), the total fat and oil consumption falls within the national consumption range of 19.8-23.1 kg. The structure of consumption of individual fats is as follows: vegetable fats and oils represent 64.9%, butter and lard 34.6%, and other fats 0.5%. Consumption of lard from 2011 has an ascending character, reaching a consumption of 3.7 kg per person/year in 2016 (SO SR, 2018).

At present, primitive breeds can keep interest in market demand from an economic point of view. The specific characteristics of meat products and the fact that they are derived from traditional breeding systems increase their value. Consumers today seek and value products obtained from the most natural conditions. Sensory indicator values are important when choosing a product for consumers as well as for economic value. Nevertheless, scientific evidence is required to prove the biochemical properties of the mangalitsa meat. Meat and mangalitsa products begin to gain public and media attention. As it has been mentioned, in the past the production of this breed has been reduced. Since 2011, the number of mangalitsa breed has started to increase because of the quality of the products obtained from traditional fattening (Cordis et al., 2015). In recent years, a number of publications has been published in relation to fatty acid and cholesterol content in meat and fatty deposits. Hungarian scientists studied fatty acids and cholesterol containing fatty tissue in mangalitsa and mangalitsa crosses. They determined that the content of unsaturated fatty acids exceeded 60% in mangalitsa fat and reached almost the same percentage in crosses (Parunovič et al., 2015). Nistor et al. (2012) report that mangalitsa lard has 12-16% less saturated fatty acids and 8-10% more unsaturated fatty acids (omega 3 and omega 6) than modern breeds of pigs. Research results of Debrececi et al. (2016) suggest that the use of the mangalitsa for crossbreeding with pork meat breeds can improve the quality of the meat and fat of hybrids that are desirable for the production of special meat products. Parunovič (2015) in research has shown that nutrition and condition affect the ratio of omega 6 and omega 3 polyunsaturated fatty acids in mangalitsa meat.

Scientific hypothesis

This study was designed to investigate the effects of consumption of lard processed from crossbreed of the original mangalitsa genotype and the breed of meat type pigs on the lipid profile of consumers.

MATERIAL AND METHODOLOGY

The research was carried out on the basis of a clinical study conducted at the Department of Animal Nutrition and the Department of Animal Husbandry at the Slovak Agricultural University in Nitra aimed at monitoring the effect of regular consumption of lard processed from crossbreed of the original genotype of mangalitsa and breed of meat type pigs with regard on selected biochemical parameters of the probands. The study was aimed at assessing the lipid profile of the probands with the determination of the essential lipid parameters in the blood. The probands were volunteers from the ordinary population. The condition for participation in the research was the consent of probands with the conditions of the study and the examinations that they had to undergo during the research. Twenty nine probands, of which 14 women and 15 men participated in the survey. The monitored group was made up of employees and students of the Slovak University of Agricultural in Nitra, aged 21 – 59. The mean age of females was 45.8 ± 9.6 years and the mean age of males was 38 ± 11.4 years. The monitored group of probands was comprised of persons without pathological changes in the basic haematological and biochemical parameters of blood.

Prior to commencement of regular consumption of lard (1st sample), the venous blood was collected by probands and the anthropometric measurements were performed a scheduled. The second sampling and measurement took place immediately after the end of 5 weeks of consumption and the third collection and the measurements were performed with one month delay. Probands consumed a dose of lard with a bakery product 4 times a week (3 times on weekdays and 1 time during the weekend) during 5 weeks. The daily dose for women was determined at 20 g of lard and 40 g for men. Lard was processed by frying at a constant temperature of 130 °C.

Fatty acid content determination was performed by Capillary Gas Chromatography (GC) with Agilent Technologies 6890N (Agilent, Waldbronn, Germany) with a flame ionization detector and a 5973 Network mass-selective detector. Capillary column 100m x 0.25 mm i.d. x 0.2 µm stationary phase HP-88 thick film (J & W Scientific, Agilent Technologies, CA, USA) was used to separate FAME.

Blood collection, anthropometric measurements as well as analyzes were performed in the laboratories of the Department of Human Nutrition of FAPZ SPU in Nitra. Blood serum lipid profiles (T-C, HDL-C and TG) were determined using the DiaSys commercial kits (Diagnostic Systems GmbH, Holzheim, Germany) of Randox with Biolis 24i Premium Biochemical Analyzer (Tokyo Boeki Machinery Ltd., Japan). The LDL-C level was calculated by the Friedewald equation.

Statistic analysis

The results were evaluated with appropriate standard mathematical - statistical methods and are listed in the following tables. The STATISTICA Cz program 10 was used for the statistical programs in MS Excel 2007. All data were expressed as the mean standard deviation (SD), differences between the values before and after the consumption were tested by a paired Student t-test. $p < 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

Content of fatty acids in lard is presented in Table 1.

To assessment of the effect of consumption of lard on the level of total cholesterol

From the biochemical blood indicators, we established an average total cholesterol of 6.07 ± 1.02 mmol.L⁻¹ prior to the beginning of regular consumption of lard (1st sample), with women having a higher TC level of 6.4 ± 0.85 mmol.L⁻¹, as for men 5.81 ± 1.07 mmol.L⁻¹. Only 7% of women and 26% of men (up to 5.2 mmol.L⁻¹) were in the blood T-C reference range. 36% of women and 47% of men had elevated T-C ($5.2 - 6.2$ mmol.L⁻¹) and a risk level (above 6.2 mmol.L⁻¹) was found in 57% of females and 27% of males. Hypercholesterolemia (values above 6.2 mmol.L⁻¹) were observed in 41% of the probands, averaging 7.03 ± 0.60 mmol.L⁻¹, which signalizes that probands were at increased risk of developing cardiovascular disease (CVD). Similar data on the risk of developing cardiovascular disease is reported by Aiglova (2017). After 5 weeks of consumption of lard (2nd sample), we observed a decrease in TC level by an average of 0.22 mmol.L⁻¹ (in

Table 1 Content of fatty acids in lard.

Fatty acids	g.100g ⁻¹ FAME	Fatty acids	g.100g ⁻¹ FAME	Fatty acids	g.100g ⁻¹ FAME
myristic acid	1.57	oleic acid	41.19	polyunsaturated	9.58
palmitic acid	26.43	linoleic acid	8.34	monounsaturated	44.80
palmitoleic acid	2.70	α -linolenic acid	0.52	saturated	41.59
heptadecanoic acid	0.30	arachidic acid	0.17	ratio $\Sigma n3/\Sigma n6$	0.07
stearic acid	13.12	arachidonic acid	0.17	ratio $\Sigma n6/\Sigma n3$	14.24

Note: FAME - fatty acid methyl ester

Table 2 The comparison of the lipid profile of men during the experiment.

Lipid profile	1 st sample	2 nd sample	3 rd sample
Total cholesterol (mmol.L ⁻¹)	5.77 ±1.11	5.72 ±1.10	5.98 ±1.10
LDL cholesterol (mmol.L ⁻¹)	3.49 ±0.71	3.51 ±0.84	3.55 ±0.76
HDL cholesterol (mmol.L ⁻¹)	1.37 ±0.33	1.39 ±0.31	1.45 ±0.33
Triacylglycerol (mmol.L ⁻¹)	1.99 ±1.35	1.77 ±0.79	2.13 ±1.23

Table 3 The comparison of the lipid profile of women during the experiment.

Lipid profile	1 st sample	2 nd sample	3 rd sample
Total cholesterol (mmol.L ⁻¹)	6.40 ±0.88	6.00 ±1.06 ^{*a}	5.88 ±0.80 ^{*b}
LDL cholesterol (mmol.L ⁻¹)	3.94 ±0.83	3.67 ±0.97 ^{*a}	3.57 ±0.81 ^{**b}
HDL cholesterol (mmol.L ⁻¹)	1.85 ±0.43	1.72 ±0.42	1.69 ±0.36 ^{*b}
Triacylglycerol (mmol.L ⁻¹)	1.35 ±0.69	1.32 ±0.68	1.36 ±0.50

Note: 1st sample – baseline, 2nd sample - after 5 weeks of consumption, 3rd sample - 1 months after end of consumption, the levels of statistical significance chosen for the comparisons were $p < 0.05$ (*), $p < 0.01$ (**); a – intra- group differences;

women by 0.40 mmol.L⁻¹ and 0.05 mmol.L⁻¹ in men) (Table 2 and Table 3). Statistically significant differences were observed in the group of probands with hypercholesterolaemia where we noticed lower values in second sample in average by 0.55 mmol.L⁻¹ in the whole batch of probands with $p < 0.05$ (Figure 1). The $p < 0.05$ (Figure 1) also corresponds with results in women where it represents a reduction in total cholesterol averaging 5.88 ±0.80 mmol.L⁻¹ (Table 3) 4 weeks after ending their consumption.

The evaluation of the effect of consumption of lard on LDL cholesterol levels

Prior to consumption of the lard (1st sample), we recorded an average LDL cholesterol level of 3.70 ±0.79 mmol.L⁻¹. In females an average value at 3.94 ±0.83 mmol.L⁻¹ whereas in males 3.49 ±0.71 mmol.L⁻¹. Optimal LDL cholesterol levels which should be up to 2.5 mmol.L⁻¹, were not present in any of the women and only in 7% of men. Upper borderline (up to 3.35 mmol.L⁻¹) was found in 21% of women and 33% of men. Above this limit, LDL cholesterol levels were detected in 79% of women and 60% in men. This high level of LDL cholesterol is considered to be a risk factor for the development of atherosclerosis (Kaško et al., 2017). Total reduction in LDL cholesterol was 0.11 mmol.L⁻¹ (in females by 0.27 mmol.L⁻¹) after 5 weeks of consumption of lard (2nd sample) and a slight increase of 0.02 mmol.L⁻¹ in males. Four weeks after ending of consumption (3rd sample), we recorded a slight decrease in LDL cholesterol by 0.03 mmol.L⁻¹, in women by 0.10 mmol.L⁻¹. In men, on the other hand, an increase of 0.04 mmol.L⁻¹ compared to the second sample (Table 2). From the results we can see that consumption of lard 20 g in women and 40 g in men 4 times per week for 5 weeks has

significantly manifested in lowering of total cholesterol levels, especially in women, which was associated with LDL cholesterol lowering ($p < 0.01$) (Figure 2), and lowering of HDL cholesterol. Our results compared with Stewart et al. (2001) confirmed the similarity between consumption of lard and LDL cholesterol in women.

Nelson (2013) puts emphasis on reducing LDL cholesterol, leading to a significant decrease in cardiovascular morbidity and mortality. However, despite the emphasis on controlling LDL cholesterol, a number of cardiovascular diseases occur in people without clinically abnormal LDL cholesterol levels. One way to prevent disease and improve treatment is to concentrate on HDL cholesterol rather than on LDL cholesterol.

The evaluation of the effect of consumption of lard on HDL cholesterol levels

The HDL cholesterol level was 1.60 ±0.45 mmol.L⁻¹ on average before lard consumption, namely 1.85 ±0.43 mmol.L⁻¹ in females and 1.37 ±0.33 mmol.L⁻¹ in males. Reference values up to 1.55 mmol.L⁻¹, were detected only in 29% of women and 66% in men, while other probands had higher values. Low values below 1.0 mmol.L⁻¹ were not determined in any women and 7% in men (Table 2 and Table 3). Optimal level of HDL cholesterol showed 52% of the probands, which could protect them from the onset of cardiovascular disease. These results are confirmed by the findings of Aigl's research (2017). After 5 weeks of consumption with probands, HDL cholesterol was reduced to 1.55 mmol.L⁻¹ ±0.76 mmol.L⁻¹ (in women to 1.72 ±0.42 mmol.L⁻¹, in men to the contrary, a positive increase to 1.39 mmol.L⁻¹ ±0.31 mmol.L⁻¹) (Figure 3).

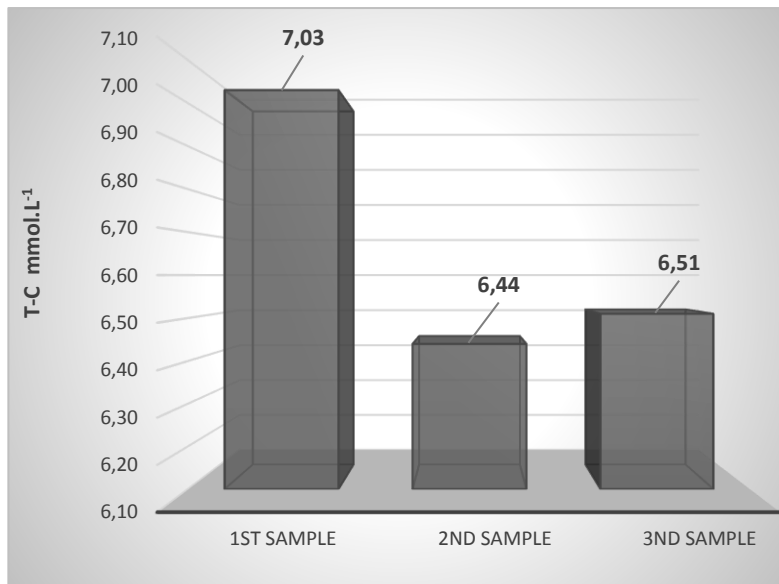


Figure 1 The comparison average value of cholesterol of probands with hypercholesterolemic.

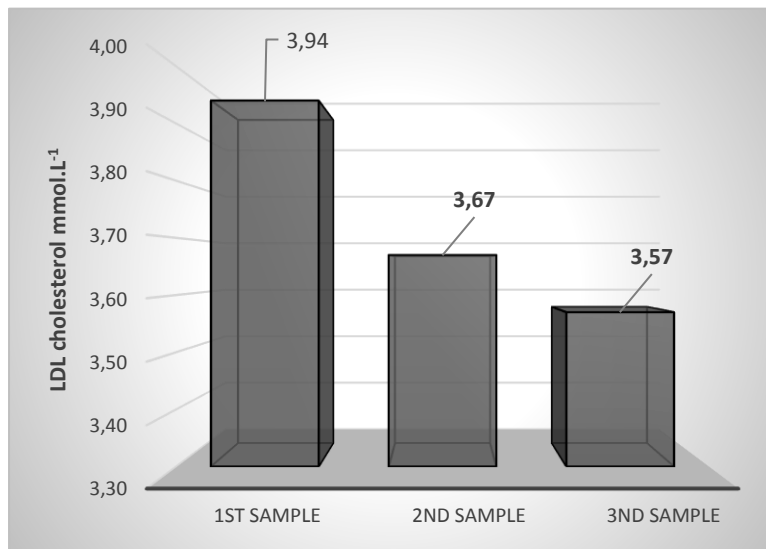


Figure 2 The comparison of average values of LDL cholesterol of women.

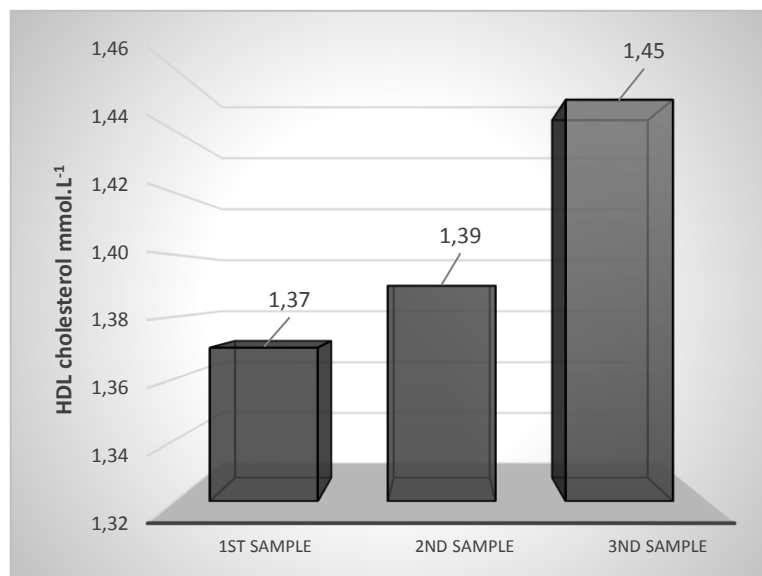


Figure 3 The comparison of average values of HDL cholesterol of men.

From the results it is conclusive that the reduction of total cholesterol by the regular consumption of lard in women is related to lipid metabolism probably within a certain age range from 20 to 60 years. At the same time, the results also indicate that the rise in LDL cholesterol in men is proportional to the rise in HDL cholesterol.

Similar results of the lipid spectrum in men, together with consumption of lard are reported by **Imaki et al. (1989)**. It is important to highlight the different HDL cholesterol values measured in men and women. In general, men have lower HDL cholesterol than women. From the results measured 9 weeks after onset of consumption (3rd sample), we found a decrease in HDL cholesterol by an average of 0.04 mmol.L⁻¹, in famels by 0.16 mmol.L⁻¹ and in males an increase by 0.08 mmol.L⁻¹ (Table 2 and Table 3). **Biju et al. (2015)** report that metabolic syndrome increases with the age and is more frequent in women. Low HDL cholesterol and elevated levels of triacylglycerols are associated with the prevalence of metabolic syndrome. Low HDL cholesterol occurs more frequently in women, whereas hypertriacylglycerolimia is more common in men.

The evaluation of the effect of consumption of lard on the level of triacylglycerols

In the 1st blood serum sample, the mean triacylglycerol levels were 1.68 ±1.11 mmol.L⁻¹, in women 1.35 ±0.69 mmol.L⁻¹ and in men 1.99 ±1.35 mmol.L⁻¹. A borderline of up to 2.25 mmol.L⁻¹ was recorded in 93% of women and 60% of men. Above this value, the level of triacylglycerols was measured in 7% of women and 40% of men. In the 2nd sample, we observed a decrease in the average level of triacylglycerols by 0.13 mmol.L⁻¹, in women by 0.03 mmol.L⁻¹ and in men by 0.22 mmol.L⁻¹. In 3rd blood serum sampling, the mean level of triacylglycerols was 1.76 ±1.01 mmol.L⁻¹, with women almost unchanged and 0.14 mmol.L⁻¹ (Table 2) in men.

The effect of eating lard on lipid and hormonal parameters of women was studied by **Jansen et al. (1999)**. They found that obese women had significantly higher fasting concentration and postprandial responses of plasma total triacylglycerol, compared to the normal-weight women. The obese women had a fasting leptin concentration of four times the normal-weight women. Postprandial changes in leptin concentrations did not occur. The results of HDLcholesterol are significantly lower in obese women than in normal-weight women. These results provide the evidence that obese women have exaggerated lipid and hormone responses compared to normal-weight women.

CONCLUSION

In recent years, cholesterol views have been reevaluated as well as opinions on food with higher cholesterol levels and are no longer very problematic. No scientific research has so far substantiated or rebutted the view that consumption of lard is detrimental. The results of our research, as well as from other sources did not confirm the current views that exclude lard from a rational diet with a justification for a negative effect on the healthy human organism. As we observed 29 probands, we did not detect negative health changes after a regular 5 week lard consumption. From the results of our study, we can conclude that consumption of lard processed from the transgenic genotype of the original mangalitsa genotype and

the breed meat-type pigs in the recommended amount is beneficial in human nutrition.

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