# QUALITY CHARACTERISTICS OF MEAT FROM PODOLICA AND CROSSBRED CALVES REARED ON FEED CONTAINING GRAPE SKINS

Marsico G., Dimatteo S., Ragni M., Rasulo A., Di Turi L. and Vicenti A.
Department of Animal Production, Via G. Amendola, 165/A - 70126 University of Bari, Italy

## Background

During the last few years, an acceleration in the disappearance of livestock breeds has occurred, due to the replacement of traditional rearing systems with simplified industrial production systems. The Rio de Janeiro "International Bio-diversity Conference" formulated proposals to contrast this trend, consisting of a series of operations and incentives aimed at recovering breeds in danger of extinction.

Podolica cattle are an indigenous Italian genotype, which recently received the status of "breed" with the establishment of a Genealogical Register. The intrinsic features of this breed merit particular attention, and consist of great adaptability to difficult climatic and environmental conditions, together with the quality and dietary characteristics of its meat. Farming of Podolica cattle is concentrated in the "inland" areas of southern Italy (Apulia, Abruzzo, Basilicata, Calabria, Campania and Molise), with about 100,000 head (AIA, 2002). This breed still contains several local varieties and up until a few years ago was used almost solely for heavy farm work. With the advent of mechanisation, its importance disappeared and numbers fell constantly. The outstanding flavour and appearance of Podolica meat have earned it the "5R" grade of certified origin, the same as four other indigenous national genetic types (Chianina, Marchigiana, Maremmana and Romagnola). The ability of this breed to exploit foodstuffs with a low nutritional content may be used in order to exploit alternative food sources such as agri-industrial by-products. In Italy, where a great amount of animal feed is imported from abroad, there is a growing interest in these by-products for livestock feed, because they are inexpensive and easy to obtain. Furthermore, the following advantages derive from their use: - reduced pollution due to lack of environmental impact; - reduced production costs to the breeder; - a considerable alternative supply of nutrition; - probable improvements in the flavour and appearance, physical and chemical characteristics of the animal products (D'Urso et al., 1984; Bosi et al., 1985). The choice of by-products is vast, and grape skins are of particular interest because of their suitable chemical composition (12.76% raw protein, 7.73% fat, 46.70% N-free extracts) low cost and, in Apulia, wide availability. Grape skins have already been tested on lambs without negative repercussions on productive performances, or quantity and quality traits. Moreover, when this by-product was added to lamb feed together with grape-seed oil and safflower oil, it determined a higher level of unsaturated and monounsaturated fatty acids (Chiericato and Rioni, 1983; Bittante et al., 1985; Bosi et al., 1985; Vicenti et al., 1996; Ragni et al., 1997; Ragni et al., 1998; Vicenti et al., 1997).

## Objectives

The study aims to evaluate the influence of a feeding treatment containing 20% grape skins on the chemical composition and on the fatty acid profile of meat from thoroughbred and crossbred (Marchigiana x Podolica and Chianina x Podolica) Podolica calves.

## Materials and methods

24 male calves were used for this study, 8 Podolica (Pod), 8 Chianina x Podolica (Ch x Pod) and 8 Marchigiana x Podolica (Mar x Pod), weaned at about 6 months. Each genotype was divided into 2 groups, with each group containing 4 animals. The animals were fed a diet made of feed (about 60% of the dry matter of the diet) and of hay from permanent pasture (about 40% the dry matter of the diet). One group of each genotype (Test) was fed a control feed with no grape skins, whereas the other groups (Grape skin) received a feed containing 20% grape skins. Table 1 shows the chemical composition of the feeds, carried out in accordance with A.S.P.A. regulations (1980). The calves were slaughtered at a live weight of 450 kg to 500 kg, when breeders and the local market consider them mature. The *Longissimus dorsi* (LD) and *Biceps femoris* (BF) muscles were removed from all carcasses and assessed for pH, using a glass electrode at slaughter. Samples of both the muscles examined were evaluated for meat colour and tenderness. A representative sample was used for chemical analysis (ASPA, 1996) and fatty acid profile. Lipids were

extracted according to the 2:1 chloroform-methanol method described by Folch *et al.* (1957), whereas the acidic profile was assessed using a Chromopack CP 9000 gas chromatograph. Meat colour was estimated by the Hunter Lab system using a colorimeter (illuminant D 65), which measures the values of Lightness (L), Redness (a) and Yellowness (b) by making 5 readings for each meat sample, approximately 2.5 cm thick. Tenderness was measured using a Warner Bratzler shear device applied to an Instron 5544 and expressed as the cutting force ($kg/cm^2$) required to shear perpendicularly to the direction of the fibres half an inch diameter cylinders of raw meat, taking three measurements for each muscle per subject. The atherogenicity and thrombogenicity indexes were calculated accordingly to Ulbricht and Southgate (1991). The PCL/PCE (plasma cholesterol lowering/plasma cholesterol elevating) ratio was also determined (Reiser and Shorland, 1990). Data were analyzed for variance using the GLM procedure of SAS (1999/2000).

## Results and discussion

The effect of diet on the physical parameters (Tab. 2) of the LD and BF muscles was limited, since it had a significant effect only on the lightness index ($P<0.05$) and the shear force WBS ($P<0.01$) of the LD muscle. Genotype had a significant effect only on the yellowness index b ($P<0.05$) and tenderness ($P<0.01$) of the LD muscle, and on the pH ($P<0.05$) of the BF muscle. Considering the effect of the interaction diet x genotype, it is seen that Pod bullocks fed on grape-skins present LD muscle which tends to be less light ($P<0.05$) and the BF muscle with less red and yellow intensity ($P<0.05$ and $P<0.01$). The degree of acidity of the LD muscle was not influenced by genotype and diet, unlike the BF muscle; the BF muscle from Mar x Pod bullocks fed on grape-skins presented the highest pH values ($P<0.01$ and $P<0.05$). However, the type of feed produced different effects among the three genotypes regarding the shear force of the LD muscle. The feed containing grape-skins significantly ($P<0.01$) increased the hardness of the Pod meat when compared to the Ch x Pod and Mar x Pod meat. The use of grape-skins caused significant variations in the chemical composition of the meats (Tab. 3). Both diet and genotype produced considerable differences in the content of water, fat ($P<0.01$ and/or $P<0.05$) and protein. The combined effect diet x genotype gave rise to effects on the water content of meat from animals fed on the grape-skin diet. In the Ch x Pod and Pod bullocks this was significantly reduced ($P<0.01$ and $P<0.05$). The protein content of the meats from the different genotypes was influenced by the type of diet. In particular, the grape-skin diet led to a reduction in the protein content of meat from bullocks. The fat content of meat was also influenced by both genotype and feed, since the grape-skin diet caused a highly significant increase ($P<0.01$) in the lipid content of Pod meat. The acid composition of the fat (Tab. 4) was affected by the type of diet, with significant variations in the contents of saturates, unsaturated, monounsaturated and ω3, the unsaturated/saturated ratio and the thrombogenicity index. The genotype also has a significant effect on all parameters of acid composition of fat, except for the ω3/ ω6 ratio. The diet x genotype interaction has also shown significant variations in almost all the parameters considered. It can be seen how the grape-skin diet favoured ($P<0.01$ and/or $P<0.05$) a greater accumulation of unsaturated and monounsaturated fatty acids in the Pod bullocks, and reduced the accumulation of saturated fatty. The ω6 and ω3 contents were affected in different ways by the grape-skin diet, which reduced both acids in the Pod bullocks ($P<0.01$and $P<0.05$). Finally, the effect of the grape-skin diet was pronounced on the dietetic indexes. Meat from Pod bullocks showed, mostly on Grape skin diet, better thrombogenic index ($P<0.01$) than the other groups.

## Conclusions

The experimentation showed that the use of feed containing 20% grape-skins in the diet of different genotypes of meat bullocks generally produced good quality meat and dietary characteristics. With reference to the Podolica breed, an indigenous genotype typical in Southern Italy, it was seen that a grape-skin diet produced meat with a higher content of unsaturated and monounsaturated fatty acids, reduced saturated acids, and led to an improvement in the dietary indices considered beneficial for human health.

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**Table 1**. Chemical composition of grape skin and diets (% on dry matter)

| | Diet | | |
|---|---|---|---|
| | Grape skin | Test | Grape skin |
| Moisture | 3.00 | 8.80 | 8.20 |
| Protein | 12.76 | 17.03 | 17.06 |
| Fat | 7.73 | 4.92 | 4.73 |
| Ash | 9.13 | 8.44 | 8.21 |
| Fiber | 23.68 | 10.98 | 9.87 |
| N-free extract | 46.70 | 58.63 | 60.13 |

**Table 2.** Color, pH and tenderness parameters

| | Diet x Genotype | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Test | | | Grape skin | | | | | |
| N (samples) | 4 | 4 | 4 | 4 | 4 | 4 | | P | SED |
| Variables | Ch x Pod | Mar x Pod | Pod | Ch x Pod | Mar x Pod | Pod | Diet | Genotype | FD=18 |
| LD L | 28.59 $^{B}$ | 28.70 $^{a}$ | 29.95 | 32.42 $^{a}$ | 32.31 $^{a}$ | 28.65 $^{a}$ | * | n.s. | 2.404 |
| a | 9.50 $^{B}$ | 13.23 $^{a}$ | 9.69 $^{a}$ | 11.40 | 10.00 | 9.95 | n.s. | n.s. | 2.302 |
| b | 8.10 $^{A}$ | 8.45 $^{a}$ | 6.39 $^{a}$ | 8.35 $^{a}$ | 7.20 | 6.77 | n.s. | * | 1.146 |
| BF L | 31.23 | 31.56 | 31.38 | 31.99 | 30.83 | 28.48 | n.s. | n.s. | 2.467 |
| a | 10.11 | 9.63 $^{aa}$ | 10.94 | 11.88 $^{a}$ | 12.91 $^{Aa}$ | 8.58 $^{Ac}$ | n.s. | n.s. | 2.039 |
| b | 7.28 $^{ABC}$ | 6.29 $^{cd}$ | 7.39 $^{aac}$ | 7.53 $^{a}$ | 7.56 $^{a}$ | 5.87 $^{d}$ | n.s. | n.s. | 0.844 |
| LD pH | 6.49 | 6.48 | 6.33 | 6.49 | 6.59 | 6.58 | n.s. | n.s. | 0.284 |
| BF pH | 6.21 $^{cd}$ | 6.37 $^{ac}$ | 6.02 $^{Aad}$ | 6.19 $^{ac}$ | 6.55 $^{Aa}$ | 6.20 $^{ac}$ | n.s. | * | 0.231 |
| LD WBS (kg/cm$^2$) | 7.50 $^{A}$ | 5.55 $^{C}$ | 5.50 $^{C}$ | 5.60 $^{C}$ | 5.60 $^{C}$ | 6.25 $^{A}$ | ** | ** | 0.153 |

$^{A, B, C, D}$: P<0.01; $^{a, b, c, d}$: P<0.05

**Table 3.** Chemical composition of meat (%)

| | Diet x Genotype | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Test | | | Grape skin | | | | | |
| N (samples) | 4 | 4 | 4 | 4 | 4 | 4 | | P | SED |
| Variables | Ch x Pod | Mar x Pod | Pod | Ch x Pod | Mar x Pod | Pod | Diet | Genotype | FD=18 |
| Moisture | 70.78 $^{A}$ | 71.03 $^{A}$ | 66.66 $^{Ca}$ | 68.10 $^{B}$ | 70.34 $^{A}$ | 65.55 $^{CDb}$ | ** | ** | 0.624 |
| Protein | 23.40 $^{a}$ | 22.74 | 23.83 $^{Aa}$ | 21.89 $^{b}$ | 21.66 $^{Bb}$ | 21.62 $^{Bb}$ | * | * | 0.991 |
| Fat | 4.36 $^{D}$ | 4.78 $^{D}$ | 8.20 $^{B}$ | 8.07 $^{B}$ | 6.23 $^{C}$ | 10.00 $^{A}$ | ** | ** | 0.586 |
| Ash | 1.05 $^{a}$ | 1.03 $^{a}$ | 0.91 | 0.96 | 0.84 $^{b}$ | 0.93 | n.s. | * | 0.110 |
| Undetermined | 0.40 $^{B}$ | 0.40 $^{B}$ | 0.98 $^{B}$ | 0.97 $^{b}$ | 0.98 $^{b}$ | 1.89 $^{Aa}$ | * | ** | 0.530 |

$^{A, B, C, D}$: P<0.01; $^{a, b, c, d}$: P<0.05

**Table 4.** Fatty acids of meat fat (%)

| | Diet x Genotype | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Test | | | Grape skin | | | | | |
| N (samples) | 4 | 4 | 4 | 4 | 4 | 4 | | P | SED |
| Variables | Ch x Pod | Mar x Pod | Pod | Ch x Pod | Mar x Pod | Pod | Diet | Genotype | FD=18 |
| Saturated | 49.80 $^{aB}$ | 48.80 $^{Bb}$ | 48.35 $^{C}$ | 54.00 $^{A}$ | 48.85 $^{Bb}$ | 47.30 $^{D}$ | ** | ** | 0.496 |
| Unsatured | 50.20 $^{bC}$ | 51.20 $^{aC}$ | 51.65 $^{B}$ | 46.00 $^{D}$ | 51.15 $^{aC}$ | 52.70 $^{A}$ | ** | ** | 0.496 |
| Monounsaturated | 45.00 $^{Bb}$ | 47.20 $^{Ab}$ | 45.75 $^{aB}$ | 40.60 $^{C}$ | 45.95 $^{aB}$ | 48.00 $^{Aa}$ | ** | ** | 0.502 |
| Polyunsaturated | 5.20 $^{Abc}$ | 4.00 $^{Bd}$ | 5.90 $^{Aa}$ | 5.40 $^{Aab}$ | 5.20 $^{Abc}$ | 4.70 $^{Bc}$ | n.s. | * | 0.365 |
| ω6 | 4.20 $^{B}$ | 3.10 $^{C}$ | 4.95 $^{A}$ | 4.60 $^{AaB}$ | 4.05 $^{Bb}$ | 3.45 $^{C}$ | n.s. | * | 0.271 |
| ω3 | 0.30 $^{Aa}$ | 0.15 $^{B}$ | 0.30 $^{Aa}$ | 0.20 $^{b}$ | 0.20 $^{b}$ | 0.20 $^{b}$ | * | * | 0.033 |
| ω6/ω3 | 16.12 $^{b}$ | 23.00 $^{a}$ | 16.50 | 23.00 $^{a}$ | 20.25 | 17.25 | n.s. | n.s. | 8.593 |
| Unsatur./Satur. | 1.01 $^{Cb}$ | 1.05 $^{aBC}$ | 1.07 $^{B}$ | 0.85 $^{D}$ | 1.05 $^{aBC}$ | 1.12 $^{A}$ | ** | ** | 0.021 |
| Atherog. index | 0.97 $^{aB}$ | 0.95 $^{aB}$ | 0.95 $^{aB}$ | 1.06 $^{A}$ | 0.87 $^{Bb}$ | 0.97 $^{aB}$ | n.s. | ** | 0.047 |
| Thrombog. Index | 1.83 $^{B}$ | 1.80 $^{Bca}$ | 1.72 $^{CDb}$ | 2.21 $^{A}$ | 1.81 $^{BC}$ | 1.68 $^{D}$ | ** | ** | 0.042 |
| PCL/PCE | 0.83 $^{Bc}$ | 0.85 $^{BD}$ | 0.92 $^{Aa}$ | 0.74 $^{C}$ | 0.92 $^{Aa}$ | 0.87 $^{Ab}$ | n.s. | ** | 0.030 |

$^{A, B, C, D}$: P<0.01; $^{a, b, c, d}$: P<0.05