UDK 636.2.033

Izlaganje sa znanstvenog skupa
Conference paper

ORGANIC BEEF PRODUCTION SYSTEM: CARCASS AND MEAT QUALITY

C. Russo, G. Preziuso

Summary

The aim was to verify organic system effect on carcass and meat quality of beefs. Twelve carcasses derived from Limousine x Red Pied beef, reared in the San Rossore Park (Tuscany) and slaughtered at 24 months of age, were used.
After 24h post-mortem, carcasses were evaluated according to UE classification grid: on right half carcasses several measurements were taken and carcass compacteness was calculated. After 7 days of ageing longissimus thoracis, semitendinosus and triceps brachii muscles were analysed for pH, meat colour, water holding capacity, tenderness, chemical composition, fatty acid and cholesterol content. Results underlined the good quality of meat obtained from organic system in terms of colour, tenderness, water holding capacity and suitability for domestic storage. The meat had a low content of intramuscular fat; atherogenic and thrombogenic indices were rather high, testifying the high saturated fatty-acids content, probably due both to the inadequate finishing period, both to the high slaughtering age. An appropriate finishing period, in respect of the organic guidelines, should anticipate slaughtering age and improve carcass performance, obtaining higher intramuscular fat, and perhaps lower atherogenic and thrombogenic indices. Semitendinosus appeared agreeable due to its paler and lighter meat, but was less tender and had worst water holding capacity; instead longissimus thoracis and triceps brachii, although slightly darker, gave meat more tender and with better water holding capacity.

Introduction

Organic meat production is regulated by specific guidelines concerning

Rad je priopćen na "54th Annual Meeting of the EAAP", Roma 2003.

C. Russo, G. Preziuso, Department of Animal Production, University of Pisa, Viale delle Piagge n° 2 - Pisa, Italy.

rearing, feeding and therapy (Council Regulation (EC), 1999, Nos 2092/91 and 1804/99). Therefore, the absence of residues in the meat is assured, but effects on the qualitative characteristics of the products are almost unknown, and at present very few studies on this argument can be found in the literature (Castellini et al., 2002; Morbidini et al., 2000; Preziuso et al., 1998; Preziuso and Russo, 2003).

Thus, the aim of this research was to evaluate carcass and meat quality of beef from cattle reared according to the organic system in San Rossore Park, in Tuscany.

Material and methods

The twelve carcasses studies were from male Limousine x Red Pied beef cattle, reared on the same organic farm and slaughtered in a commercial EU-licensed abattoir at the average age of 24 months. After 24 h post-mortem, carcasses were evaluated according to EU classification grid for conformation and state of fattening (Massi and Faccincani, 1985); on right-half carcasses several linear measurements were taken (ASPA, 1991): carcass length, chest depth, length and maximum leg width. Carcass evaluation was supplemented by calculation of carcass compactness (carcass weight/carcass length).

To obtain further information about meat quality, after 7 days of ageing, three muscles were analysed: *triceps brachii* muscle was removed from the forequarters, while *longissimus thoracis* and *semitendinosus* muscles were excised from hindquarters. The muscle pH (mean value: 5.47) was determined using a Hanna pH211 pH-meter provided with a Hanna FC 200B electrode and an automatic temperature compensator. To evaluate meat quality, muscles were analysed instrumentally, to determine the following characteristics:

- Meat colour, using a Minolta CR300 colourmeter (Illuminant D 65), calibrated against a standard white tile in the CIEL*a*b* system, which measures the values of coordinates lightness (L*), redness (a*), yellowness (b*), saturation (C*) and hue (H*) (Renerre, 1982).
- Meat colour after 48h, on the same sample kept at 4°C for 48h to show any possible "alteration" of colour during meat storage.
- Water-holding capacity, expressed as drip loss (percentage of water lost during storage at 4°C for 48h in a plastic container with a double bottom), cooking loss (percentage of water lost during cooking in an airy oven at 180°C to an internal temperature of 75°C) and meat/total ratio (M/T) (filter paper press method, Grau and Hamm, 1957).

- Tenderness, measured as the shear force (kg) using Warner Bratzler Shear applied to an Instron 1011, on 1-inch-diameter cylinders of raw and cooked meat.
- Chemical analysis: dry matter, ether extract, crude protein and ash (AOAC, 1990).
- Fatty acid composition using the Folch et al. (1957) extraction method; thus, atherogenic and thrombogenic indices were calculated (Ulbricht and Southgate, 1991).
- Cholesterol content of intramuscular fat (Bohac et al., 1988).

For carcass traits mean values were calculated, while for meat quality data variance analysis was carried out with the SAS (1994) software package, considering muscle as fixed effect.

Results and discussion

Table 1 reports carcass characteristics: linear measurements and carcass compactness testify that carcasses were somewhat long and not very compact (Giorgetti et al., 1991). Moreover EU carcasses evaluation showed mediocre conformation (R-) and poor state of fattening (2+), confirming that animals were not fully mature, in spite of the rather late slaughtering age.

Table 1. - CARCASS CHARACTERISTICS

n 12	Mean	Std dev.
Slaughtering age (dd)	711	15,09
Carcass weight (kg)	355.20	60,94
Conformation	R-	
State of fattening	2 +	
Carcass length (cm)	135.00	4,75
Chest depth (cm)	44.05	1,64
Length of leg (cm)	74.23	2,88
Max width of leg (cm)	28.29	2,92
Carcass compactness	2.62	0,37

Meat quality traits are shown in Table 2: as regards meat colour, *longissimus thoracis* showed the lowest values of L* and H*, and thus was a darker meat, while *semitendinosus* appeared significantly lighter (L*), and paler (H*), and consequently more agreeable as to colour characteristics.

Generally, meat colour was similar to that of meat derived from non-organic systems (Preziuso et al., 1998; Russo and Preziuso, 2000);

colorimetric characteristics did not seem to be influenced by storage, demonstrating the stability of meat colour and therefore a good suitability of meat for domestic conservation.

Table 2. - MEANS AND STANDARD DEVIATIONS OF MEAT QUALITY TRAITS

n	*Triceps brachii*	*Longissimus thoracis*	*Semitendinosus*
	12	12	12
Meat colour:			
L*	40.57 ± 3.05 b	39.60 ± 2.05 b	44.56 ±3.57 a
C*	28.40 ±2.52	26.49 ± 3.56	29.26 ±3.63
H*	24.49± 1.19b	24.18± 1.84 b	27.07 ± 3.67 a
After 48 h of storage:			
L*48	41. 58 ± 2.76 b	40.85 ±2.37 b	45.54 ±3.73 a
C*48	30.24 ±2. 10	30.72 ± 2.29	28.63 ± 2.96
H*48	26.26 ± 1.46 b	26.05 ± 0.92 b	29.21 ±1.88 a
Water holding capacity:			
Drip loss (%)	1.56 ± 0.48	1.91 ±0.67	1.60 ±0.81
Cooking loss (%)	33.55 ±4.02 b	30.65 ± 5.05 b	37.45 ± 6.46 a
M/T	0.47 ± 0.05	0.46 ± 0.06	0.44 ± 0.05
Shear force:			
on raw meat (kg)	14.47 ± 4.39 a	9.56 ±1. 30 b	17.64 ±5.68 a
on cooked meat (kg)	9.33 ± 1.63 b	9.3 1± 1.78 b	11.10±1.56a
Chemical composition:			
Dry matter (%)	23. 13 ±0.79	23.88 ± 0.97	23.74 ±1.19
Ether extract (%)	0.45 ±0.19	0.77 ± 0.48	0.49 ± 0.26
Crude protein (%)	21.57 ±0.88	22.03 ± 0.92	21.98 ±1.07
Ash (%)	1.05 ±0.04	1.02 ± 0.03	1.06 ±0.03
Atherogenic index	0.64 ±0.03	0.66 ± 0.05	0.64 ±0.04
Thrombogenic index	1.34 ±0.10	1.44 ±0.33	1.41 ±0.10
Cholesterol (mg/100g)	62.53 ± 5.91	60.27 ± 5.74	62.77 ±3. 74

On row: P≤0,05

As regards water-holding capacity, expressed by drip loss, cooking loss and M/T ratio, it is interesting to note that mean values are similar to those revealed in non-organic meat (Preziuso et al., 1998; Russo and Preziuso, 2000).

Drip loss was similar in all three muscles and very low, confirming their good aptitude for domestic storage since it is strictly related to the appearance of the meat (Warriss, 2000).

As reported in previous studies, differences in cooking loss between different muscles were noted (Monin and Ouali, 1991; Russo and Preziuso,

2000): cooking loss was significantly higher in *semitendinosus* muscle, indicating a worse water holding capacity, also confirmed by a slightly lower M/T ratio. On the contrary, *longissimus thoracis* showed the best water-holding capacity, in terms of cooking loss.

Longissitnus thoracis gave very tender meat, as shown by lowest shear force before and after the cooking process, while raw meat derived from *semitendinosus* and *triceps brachii* always resulted tougher (Acciaioli et al., 1995); however cooking process induced a considerable tenderization.

No differences in chemical composition, atherogenic and thrombogenic indices and cholesterol content of the meat derived from the three muscles were found. It is interesting to note that the meat analysed had a very low intramuscular fat content, expressed as ether extract (%) and this may compromise some of its organoleptic properties such as tenderness, juiciness, flavour, etc. (Savell and Cross, 1988 quoted in Fiems et al., 2000). Atherogenic and thrombogenic indices were somewhat high, testifying to the high content in saturated fatty-acids, probably due to the inadequate finishing period, as well as to the late slaughtering age of the animals.

Conclusion

The low values for conformation and state of fattening of carcasses showed that the feeding program of these beef cattle had probably been inadequate: in fact an appropriate finishing period, respecting organic guidelines, should be able to produce animals that mature early for slaughter, resulting in better carcass performance. In this way, it may be possible to raise the meat ether extract content, and possibly lower atherogenic and thrombogenic indices.

Beef cattle reared with the organic system gave meat with good organoleptic properties; this may encourage organic production, satisfying the increasing number of consumers who demand healthy and natural foods.

REFERENCES

1. Acciaioli A., Franci 0., Sargentini C., Pugliese C., Bozzi R., Lucifero M. (1995). Effetto della frollatura sulle caratteristiche della came di vitelloni Chianini da 16 a 24 mesi di eta. In *Proceeding A.S.P.A. XI Congress,* (pp 359-360), 19-22 June 1995, Grado, Italy.
2. AOAC. (1990). *Official methods of analysis of the Association of Official Analytical Chemists. Meat and meat products. 39* (15^{lh} ed.J. Washington DC: Publication.
3. ASPA (1991). Metodologie relative alia macellazione degli animali di interesse zootecnico ed alia valutazione e dissezione della loro carcassa. ISMEA. Roma.

4. Bohac C. E., Rhee K. S., Cross H. S., Ono K. (1988). Assesment of methodologies for colorimetric cholesterol assay *of meals. J.Food Sci.* 53, 1642-1644.
5. Castellini C., Mugnai C., Dal Bosco A. (2002). Effect of organic production system on broiler carcass and meat quality. *Meat Sci.* 60, 219-225.
6. Council Regulation (EC) (1999). No 1804/99 of July 1999 supplementing Regulation (HEX) No. 2092/91 on organic production of agricultural products. Official Journal, L 222 (24/08/1999), 1-28.
7. Fiems L.O., De Campeneere S., De Smet S., Van de Voord G., Vanacker J.M., Boucque Ch.V. (2000). Relationship between fat depots in carcasses of beef bulls and effect on meat colour and tenderness. *Meat Sci.* 56, 41-47.
8. Folch J., Lees M., Sloane Stanley G.H. (1957). A simple method for isolation and purification of total lipids from animal *tissues. J.Biol.Chem.* 256, 497-509.
9. Giorgetti A., Lucifero M, Sargentini C, Martini A., Acciaioli A. (1991). Caratteristiche produttive di vitelloni Chianini, Charolais e Limousins. 1. Rilievi in vita e alia macellazione. *Zoot.Nutr.Anim.* 17, 89-98.
10. Grau R., Hamm R. (1957). Ober das Wasserbindungsvermogen des Saugetiermuskels. II. Mitt. Uber die Bestimmung der Wasserbindung der Muskels *Zeitschr fur Lebens. - Untersuchung and Forschung* 105, 446-460.
11. Massi O., Faccincani. F. (1985). Griglia CEE. Classificazioni dei bovini. A.I.A. Roma.
12. Monin G., Ouali A. (1991). Muscle differentiation and meat quality. In "Development in meat science - 5" (Lawrie R.A., ed.), Elsevier applied science publisher, London and New York.
13. Morbidini L., Pauselli M., Valigi A., La Rovere G. (2000). Carcasse, resa in tagli e qualita delle earn! di vitelloni Chianini allevati con sistema in riconversione biologica presso un'azienda umbra. *Taurus Speciale* 11, 129-143.
14. Preziuso G., Russo C., Campodoni G., Cianci D. (1998). Performance produttive e qualita delle carni di vitelli Charolais x Maremmana allevati con metodo tradizionale o biologico. *Taurus Speciale* 9, 17-26.
15. Preziuso G., Russo C. (2003). Meat quality of beef reared with organic system. XI Congress of Mediterranean Federation Health and Production of Ruminants. 22-25 May, Olbia (SS) - Italy.
16. Renerre M. (1982). La couleur de la viande et sa mesure. *Bulletin Technique, C.R.Z. V. Theix I.N.R.A. 47,* 47-54.
17. Russo C., Preziuso G. (2000). Caratteristiche qualitative della came proveniente da vitelloni di razza Chianina:confronto fra muscoli. *Taurus Speciale* 11, 103-108.
18. SAS Institute Inc. (1994). JMP Gary. NC. USA.
19. Ulbricht T.L.V., Southgate D.A.T. (1991). Coronary heart disease: seven dietary factors. *The Lancet* 338, 985-992.
20. Warriss P. D. (2000). *Meat Science. An Introductory Text.* New York: Cabi Publishing.

SUSTAV ORGANSKE PROIZVODNJE GOVEDINE: KAKVOĆA POLOVICA I MESA

Sažetak

Cilj je bio provjeriti djelovanje organskog sustava na kakvoću polovica i mesa goveda. Upotrijebljena su 12 trupla podrijetlom od Limousina x goveda crveni Pied, uzgojenih na San Rossore Parku (Toskana) i zaklanih u dobi od 24 mjeseca.

Dvadeset i četiri sata nakon klanja trupla su procijenjena prema EU klasifikaciji: na desnim polovicama obavljeno je nekoliko mjerenja i izračunata zbijenost mesa. Nakon što je meso odležalo 7 dana analizirani su longissimus thoracis, semitendinosus i mišići triceps brachii za pH, boju mesa, kapacitet zadržavanja vode, mekoću, kemijski sastav, masne kiseline i sadržaj kolesterola. Rezultati su pokazali dobru kakvoću mesa dobivenu u organskom sustavu u odnosu na boju, mekoću, kapacitet zadržavanja vode i prikladnost za čuvanje u domaćinstvu. Meso je imalo nizak sadržaj međumišićne masnoće; aterogeni i trombogeni indeksi bili su prilično visoki, potvrđujući visoki sadržaj zasićenih masnih kiselina, vjerojatno zbog neadekvatnog završnog razdoblja a i visoke dobi kod klanja. Odgovarajuće završno razdoblje u smislu organskih smjernica, trebalo bi predvidjeti dob klanja i poboljšati rezultate polovica, čime bi se dobili viša međumišićna masnoća i možda niži aterogeni i trombogeni indeksi. Semitendinoza je izgledala dobra zbog bljeđeg i svjetlijeg mesa ali je bila slabije mekoće i imala najslabiji kapacitet zadržavanja vode; umjesto toga longissimus thoracis i triceps brachii dali su meso, iako nešto tamnije, veće mekoće i boljeg kapaciteta zadržavanja vode.

Primljeno: 10. 12. 2004.