Comparative analyses of proximal and fatty acid composition of grass-fed meat from water buffaloes (*Bubalus bubalis*) and zebu-influenced beef cattle at 24 months of age.

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Background

Currently there is a growing interest in Venezuela, Brazil and other South American countries to evaluate the water buffalo as an alternative to produce meat in tropical areas that have adverse conditions (marshy low plains and/or flooding savannas) for raising cattle, affecting beef and milk production of *Bos* species. Some studies (Valin et al., 1984; Rivera et al., 1998) have revealed that proximal composition of buffalo meat doesn't differ significantly from that of cattle. Other studies, sustain that the buffalo meat exhibit a higher proportion of polyunsaturated (AGPI), C18:0 and C20:0 fatty acids than beef. In tropical America little information exists about the bovine (cattle or buffalo) meat fatty acid composition produced on savannah, as well as of the factors that affect its nutritional properties.

Objectives

a) To compare the proximal composition of the buffalo meat vs. zebu-influenced cattle, produced under similar environmental and biological characteristics (age, sex condition and feeding).
b) To examine variation of the fatty acid composition for buffalo and zebu-influenced cattle meat produced under grazing conditions.

Methods

Animals

Samples derived from 33 male bovines (16 buffaloes and 17 cattle). Buffaloes were crossbred, with predominance of Murrah and Mediterranean breeds. Cattle were offsprings of zebu dams sired by artificial insemination with bulls of different breeds (Brahman, Black Angus, Red Angus, Romosinuano and Charolaise). The cow-calf operation was located at a ranch located at Apure State. Immediately after weaning (at 7 mo. of age) half of the bull calves from each specie was castrated. The whole experimental group was processed and transported to complete the stocking and fattening phases in a ranch located at the llanos of Cojedes State. Animals from both species grazed introduced pastures (Brachiaria spp) up to slaughter. At 24 months of age (average 736 days for buffaloes and 718 days for cattle) the whole group was slaughtered by standard procedures.

Sample collection

After 48 h postmortem, carcasses were fabricated and rib steaks (m. *longissimus dorsi*) were removed, vacuum packaged individually, identified by animal number and frozen at –20 °C for further preparation. At the laboratory the subcutaneous and intermuscular surrounding fats were trimmed off. The lean meat was then homogenized in a food processor and packaged for frozen storage at –20 °C until its final preparation for the chemical analysis. All the samples were analyzed by duplicates.

Determination of protein, moisture, ash and total lipids

Determinations were carried out in agreement with the methodology described by the A.O.A.C (1990). Total lipids were determined by the Folch et al. (1957) procedure.

Determination of fatty acids by gas phase chromatography

Samples were saponified and fatty acids were methylated following the procedure described by Morrison and Smith (1964). Each sample was mixed with 1ml (equivalent to 5 mg) of the internal standard (heneicosanoic methyl ester, C:21:0). 1.0 µl sample containing the fatty acids methyl esters (EMAG) was injected in a gas chromatograph (Perkin Elmer Autosystem), coupled with a flame ionization detector (FID). The chromatographic separation was conducted in a Supelco capillary column (SP 2560) of 100 m x 0.25 mm ID x 0.20 µm of film thickness of *Bis*-cianopropil-polisiloxane. The gas chromatograph system was calibrated with a commercial mixture of methyl esters of purified fatty acids as follows: C14:0, C15:0, C16:0, C17:0, C18:0, C20:0, C22:0, C24:0, C14:1, C16:1 *trans*, C16:1 *cis*, C17:1 *trans*, C18:1 *trans* (elaidic), C18:1 *cis* (oleico), C18:1 *trans* (vaccenic), C20:1 *cis*, C22:1, C24:1, C18:2 *trans* ω6 , C18: 2 *cis* ω6, C18:3 γ ω6, C18:3 α ω3, C20:2 *cis*, C20:3 *cis* ω3, C20:3 *cis* ω6, C20:4 ω6, C22:2 *cis*, C20:5 *cis* ω3, C22:4 ω6, C22:6 *cis* ω3 (No. GLC 534 Nu-Chek-Prep, Elysian, MN.

Statistical analysis

A complete randomized design with unequal number of animals per cell was used. When F-test of analyses of variance (ANOVA) were significant for the main effects ($P < 0.05$), means were compared by the least squares methods using SAS (1982).

Results and discussion

Effect of specie on proximal composition and fatty acid profile expressed as percentage of the total intramuscular lipids

Table 1 shows that buffalo meat contained 1,08% more protein, 1,81% more dry matter and 1,82% less moisture than beef ($P < 0.01$). Other workers have not found significant differences in proximal components when comparing meat from both species (Huerta-Leidenz et al., 1997; Valin et al., 1984; Rivera et al., 1998). Concentrations of total intramuscular fat are relatively lower to those reported for lean beef (rib steaks trimmed to zero fat cover) in United States (USDA, 1989).

Percent distribution of fatty acids (Table 3), indicated that prevailing fatty acids in the intramuscular (i.m.) lipids extracted from buffalo and cattle tissues, were, respectively, C18:1 cis (31.5% vs. 30.3%), C16:0 (20.0% vs. 20.4%), and C18:0 (12.8% vs. 12.2 %). Average concentrations found for other fatty acids in buffalo i.m. fat were: C18:2 *cis* ω6: 5.56%, 18:1 *trans* elaidic: 2.41%, and 16:1 *cis*: 1.92 percent. In cattle, i.m. fat concentrations were: C18:2 *cis* ω6: 6.5%, C14:0: 2.5%, and C16:1 *cis*: 2.1 percent.

The general trend C18:1 > C16:0 > C18:0 in cattle fat is also observed in the works of Rule and Beitz, (1986) and Eichhorn et al., (1986). In relation to buffaloes, there are not previous works discussing the profile based on percent distribution of fatty acids in i.m. fat.

Effect of sex condition on proximal composition and fatty acid profile of muscular lipids

Sex condition effects were only observed in total lipids content ($P < 0.05$). Fresh meat from castrates presented 0.24 g more total lipids/100g than that from entire males. The same trend was observed by Uzcátegui-Bracho (1997) and Huerta-Leidenz (1997) but they reported differences of greater magnitude. Fatty acid profile revealed a larger unsaturation degree in the i.m fat of entire animals, fact that agrees with previous investigations (Rhee, 1990; Uzcátegui-Bracho, 1997), supporting the theory of Eichhorn (1986), that the i.m. fatty acid composition depends on the triacylglicerols: phospholipids ratio.

Conclusions

In general, when buffaloes and zebu cattle are grass-fed and killed at the same age (24 mo.) few differences exists in chemical and lipid fatty acid composition.

Sex condition effects only revealed higher fat content of *longissimus* muscles from castrates ($P < 0.05$) as compared to the leaner muscles from entire males.

Pertinent literature

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Table 1. Least squares means and standard error for the proximal composition by specie

	Specie		
VARIABLES (g/100g)	**BUFFALO (N =16)**	**CATTLE (N =17)**	**P VALUE**
Protein	21.99 ± 0.18	20.91 ± 0.17	0.0002
Moisture	73.52 ± 0.25	75.34 ± 0.24	0.0001
Dry matter	26.46 ± 0.25	24.65 ± 0.24	0.0001

Table 2. Percent distribution of fatty acids in intramuscular lipids by specie (Least square

	Specie		
FATTY ACID	**BUFFALO (N =16)**	**CATTLE (N =17)**	**P VALUE**
C 14:0	1.83 ± 0.13	2.54 ± 0.13	0.0009
C 15:0	0.53 ± 0.05	0.74 ± 0.04	0.0078
C 24:0	0.73 ± 0.04	0.50 ± 0.04	0.0023
C 14:1	0.32 ± 0.02	0.41 ± 0.02	0.0287
C18:1*trans*(elaidic)	2.41 ± 0.15	1.92 ± 0.14	0.0313
C 18: 2 *cis* ω6	5.56 ± 0.33	6.52 ± 0.32	0.0501
C 18:3 γ ω6	0.06 ± 0.005	0.04 ± 0.004	0.0016
C 20:2 *cis*	0.15 ± 0.02	0.08 ± 0.02	0.0386
C 20:3 *cis* ω6	0.57 ± 0.05	0.38 ± 0.05	0.0161

Percent fatty acid composition in total intramuscular lipids.