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ANIMAL SCIENCE

Genetic effects on meat quality of crossbred lambs finished in confinement

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Abstract: The objective of this study was to evaluate the subjective, chemical and sensorial meat characteristics of ½ Santa Inês (SI) x ½ No Defined Racial Standard (NDRS) and ½ Brazilian Somalis (BS) x ½ No Defined Racial Standard (NDRS) crossbred lambs, finished in confinement. Sixteen uncastrated male lambs with initial weight of 19.7 ± 2.03 kg and approximately 90 days of age. A randomized block design was used, with blocks represented by the initial weight of each genetic group, with eight animals per group. There was a higher degree and distribution of marbling, percentage of lipids and meat color for ½ BS x ½ NDRS lambs. The conjugated linoleic acid profile was higher for ½ SI x ½ NDRS lambs. Considering the meat quality of the evaluated genetic groups, Santa Inês crossbred lambs have a better nutritional value for meat, especially taking into account the production of foods that are beneficial to human health.

Key words: Breed, carcass charateristics, production systems, quality, sheep.

INTRODUCTION

In a competitive meat market, strategic planning with emphasis on consumer satisfaction and demand is an important tool that determines the choice of lamb termination systems. Meat with better nutritional and sensorial quality according to some chemical and sensorial parameters can define consumer preference.

The production of lamb must use adequate nutrition technology, taking advantage of growth potential of some breed for weight gain and crossing systems (Maia et al. 2012). Sheep meat quality is affected by several factors, and genetic group is a target factor of several researches (Monte et al. 2012). Meat breed and their crosses generally present weight gain and carcass and meat characteristics superior to those of dual purpose or wool breed (Ribeiro et al. 2010).

Santa Inês and Brazilian Somalis breeds, for example, stand out because of their adaptability to Brazilian Northeastern semiarid region and ability to produce meat. F1 Lambs originated from crossing of males of these genotypes with females from undefined racial pattern can be an important alternative in meat production with better physical and chemical characteristics, since it can exploit the potential of complementarity, which favors the conjugation of desirable characteristics of each genetic group (Barbosa Neto et al. 2010).

It is fundamental, therefore, the adoption of rational breeding techniques, whose purpose is to obtain better quality meat to meet the consumers growing demands (Costa et al. 2011). Therefore, to evaluate the parameters that indicate meat quality of crossbred ½ Santa Inês x ½ No defined racial standard and ½ Brazilian Somalis x ½ No defined racial standard, it is possible to predict the degree of meat satisfaction and acceptability by consumers, favoring its commercialization.

Therefore, defining the breed or crosses better suited to the production of quality meat, knowing the techniques required for each type of production, are crucial issues for obtaining attractive products with higher added value and leading to generation of more profitable production systems, especially in semi-arid regions.

To clarify these existent questions, the objective of this study was to evaluate the meat quality of crossbred ½ Santa Inês x ½ No defined racial standard and ½ Brazilian Somalis x ½ No defined racial standard, finished in confinement in the northeastern semi-arid region.

MATERIALS AND METHODS

This study complied with the norms of the Committee of Ethics for Animal Use (CEUA) from State University Vale do Acaraú.

The experiment was carried out at Fazenda Santa Rita, a property of Embrapa Goats and Sheep, in Sobral, Ceará, Brazil. Sixteen uncastrated male lambs with initial body weight of 19.7 ± 2.03 kg and approximately 90 days old were used. A randomized complete block design was used, with four blocks defined according to initial body weight of the genetic groups, ½ Santa Inês (SI) x ½ No Defined Racial Standard (NDRS) and ½ Brazilian Somalis (BS) x NDRS, with two replicates per block. The animals were ear tagged, dewormed and confined in collective stalls with mineralized salt and water available "ad libitum".

Lambs were weighed every 14 days to adjust feed supply with a prediction of 12% of leftovers based on natural matter. The diet was composed of sorghum silage, wheat bran, soybean meal and limestone (Table I), formulated according to NRC (2007) for lambs weighing 19.7 ± 2.0 kg and a daily weight gain of 150 g, and provided in two daily meals at 7 a.m. and 3 p.m. Leftovers were weighed daily in the morning.

Chemical-bromatological analysis of foods provided to the lambs were carried out at the Animal Nutrition Laboratory of Embrapa Goats and Sheep in Sobral, Ceará, Brazil. Analyzes of dry matter (DM, method 930.15), ash (method 942.05), crude protein (CP, method 968.06) were performed according to Association of Official Analytical Chemists (AOAC 2012). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin (LIG) were determined according to Van Soest et al. (1991). The total digestible nutrients were determined according to Cappelle et al. (2001).

The animals were slaughtered at the end of 57-day confinement period. At the slaughter, the animals were mechanically desensitized in the atlanto-occipital region, followed by bleeding and sectioning the jugular vein and carotid artery. After cooling at 4°C for 24 hours in a cold chamber, their carcasses were divided longitudinally in the middle. In the left half carcass was made a cross section between 12th and 13th ribs for removal of *Longissimus dorsi* muscle.

Subsequently, a subjective evaluation of meat was performed: fat marbling (1= nonexistent up to 5= excessive), distribution of marbled fat (1= ununiform to 3= uniform), fat texture (1 = very coarse up to 3 = slightly coarse), meat texture (1 = very thick up to 4 = thin) and meat color (1 = light pink up to 5 = dark red) according to Cezar & Sousa (2007).

A section of *Longissimus dorsi* muscle was removed and frozen for further analysis. Part of the samples was used for determination of centesimal composition and profile of fatty acids and another one for sensorial evaluation.

Table I. Centesimal and chemical composition of experimental total diet and chemical composition of experimental total diet ingredients.

Centesimal composition (%)					
Sorghum silage	48.2				
Soybean meal	28.9				
Wheat bran	21.1				
Calcareous	1.8				
Chemical composition (% of dry matter)					
Nutrients	Sorghum silage	Soybean meal	Wheat bran	Calcareous	Total Diet
Dry Matter	92.3	89.7	92.2	100.0	91.7
Ashes	17.7	7.1	5.2	100.0	13.5
Crude Protein	6.4	52.8	19.3	-	22.4
Ether extract	2.3	2.5	3.7	-	2.6
Neutral detergent fiber	61.7	13.0	38.9	-	41.7
Acid detergent fiber	36.9	6.4	11.5	-	22.1
Lignin	4.6	0.5	3.8	-	3.2
Total digestible nutrients[1]	64.1	56.1	53.0	-	67.2

[1]**Total digestible nutrients estimated according to Cappelle et al. (2001) (TDN=91.0246 - 0.571588 * (neutral detergent fiber).**

Humidity (method No. 930.15), mineral matter (method No. 942.05) and protein (method No. 968.06) were determined according to AOAC (2012). Lipids were quantified according to Folch et al. (1957). Fatty acids profile was determined after extraction of total lipids and follow-up of esterification and methylation processes according to Bligh & Dyer (1959).

Sensory analysis was carried out at the Food Analysis Laboratory of the Animal Science course of Vale do Acaraú State University and counted with the evaluation of 14 trained tasters. The team was composed of seven men and seven women, aged between 20 and 30 years. A qualitative descriptive analysis was adopted, with three sessions, in which each attribute was scored as described by Stone et al. (1974), using an unstructured scale of nine centimeters, anchored at the extremities with greater intensity (9.0) or smaller (1.0), evaluating the parameters toughness (perception of the force required for the shear of sample when chewing the meat), juiciness intensity (perceivable liquid during chewing of meat), aroma (sensation of odor released by the sample), color intensity (visualization of product color *in natura*), flavor (taste sensation released by the sample) and overall appreciation (sum of all sensory perceptions, expressing the opinion of the judges on the quality of meat).

Data were submitted to analysis of variance by GLM procedure of the statistical package SAS (SAS Institute 2011) at 5% of significance. For the statistical analysis of sensorial characteristics

Table II. **Meat subjective characteristics of experimental lambs.**

Variables	Genotypes		Test F	s.e.m ⅄
	½ SI x ½ NDRS	½ BS x ½ NDRS		
Fat marbling†	2.1	3.6	<0.01	0.1066
Distribution of marbled†	1.0	2.9	<0.01	0.0625
Fat texture†	2.6	2.5	ns	0.1949
Meat texture†	2.4	2.7	ns	0.1236
Meat color†	4.1	4.3	ns	0.0843

⅄s.e.m = standard error of the mean. †Fat marbling scores (1= nonexistent up to 5= excessive); Distribution of marbled fat scores (1= ununiform to 3= uniform); Fat texture scores (1 = very coarse up to 3 = slightly coarse); Meat texture scores (1 = very thick up to 4 = thin); Meat color scores (1 = light pink up to 5 = dark red).

of lamb meat (evaluation scores), Wilcoxon non-parametric test was used. Test F was considered for comparison of means.

RESULTS AND DISCUSSION

For the subjective characteristics of meat (Table II), genetic group had a significant effect ($P < 0.05$) on degree and distribution of marbling, with higher values for lambs ½ BS x ½ NDRS. As the animals of both genetic groups were fed the same diet, the differences can be attributed to physiological behavior in development of different tissues, suggesting that animals ½ BS x ½ NDRS would reach maturity of carcass more rapidly than the animals ½ SI x ½ NDRS, whereas those animals were slaughtered with the same confinement time (57 days).

Different breeds have different maturity ages, resulting in different carcass composition, cuts and muscles, and nutritional value of meat. Silva et al. (2000) reported that newborn lambs, of breeds that reach carcass maturity earlier, have a proportion of muscles, bones and fat similar to an animal adult with late maturity. Breeds that reach carcass maturity earlier, such as Brazilian Somalis, tend to originate carcasses with greater fat deposition in meat, since they reach a physiological maturity, faster than late breed such as Santa Inês, for example (Silva et al. 2000). This is corroborated by Butterfield et al. (1984) that maturity, early or late, are terms used to indicate fat accumulation in carcass, thus, an animal with characteristic of early maturity, when slaughtered later, tends to accumulate more fat in carcass, because it reaches the slaughter weight earlier.

According to Cartaxo et al. (2011), the genotype is a determinant factor in the carcass marmorization values. Also, it is important to emphasize that animals of the Brazilian Somalis breed are characterized by accumulating fat reserves in the croup and at base of tail. These factors may also have contributed to higher values of marbling grade and distribution verified in lambs ½ BS x ½ NDRS (Table II).

Table III. Chemical composition of meat from experimental lambs.

Variables	Genotypes		Test F	s.e.m[▲]
	½ SI x ½ NDRS	½ BS x ½ NDRS		
Humidity (g/100g)	74.6	74.5	ns	0.2316
Mineral Matter (g/100g)	4.5	4.5	ns	0.0451
Protein (g/100g)	25.4	25.5	ns	0.2319
Lipids (g/100g)	1.2	2.0	0.01*	0.1017

[▲]s.e.m= standard error of the mean.

The mean for the loin color in this study was 3.44, similar between the two genetic groups evaluated (P> 0.05). This value ranks the meat between light red and red (3 to 4 points). Hopkins et al. (2007) stated that this intensity of color may favor the marketing of meat, since it indicates that it comes from young animals, more preferably by consumers.

From subjective values of fat and meat, typification is an important tool to indicate or predict quality of meat coming from the carcass (Hopkins et al. 2007). Visual Aspects such as color and texture relate to softness as well as marbling is related to juiciness and softness as well. The typification predictells quality of edible portion (Cezar & Sousa 2007).

Regarding meat centesimal composition (Table III), genotype promoted differences only in lipid content (P<0.05), observing a higher value for animals ½ BS x ½ NDRS. According to Moreno et al. (2011), genetic group has great influence on meat lipid content. The influence of genotype on meat chemical composition is more evident when comparing early to late breeds, since early genetic groups have more lipids, less moisture and protein than late animals (Moreno et al. 2011).

Osório et al. (2013) commented that finishing maturity has a direct effect on meat nutrient composition, notably on the percentage of lipids. Percentage of meat lipids observed in this study was 1.2 for animals ½ SI x ½ NDRS and 2.0 for ½ BS x ½ NDRS (Table III). Based on these results, it is possible to classify as lean meat (fewer than 5% of lipids), according to Leão et al. (2011).

The values of moisture, mineral matter, proteins and lipids are within acceptable limits for lamb meat, since the chemical composition of sheep meat presents average values of 75% moisture, 1.1% of mineral matter, 23% protein and 4% fat (Monte et al. 2012).

Concerning fatty acid profile, 14 different fatty acids were found in the meat of both evaluated genetic groups (Table IV). Among the identified fatty acids, seven are saturated, three monounsaturated and four polyunsaturated. Thus, it was verified that the highest proportions were palmitic, oleic, stearic, myristic and linoleic acids, respectively. According to Arruda et al. (2012), these are the fatty acids regularly found in sheep's meat.

Significant differences were found for conjugated linoleic acid (CLA - C18:2 9*c*, 11*t*), in which a higher value was observed for animals ½ SI x ½ NDRS (Table IV). This result can be

Table IV. Percentual composition of fatty acids of experimental lamb meat.

Fatty acids (%)	Genotypes		Test F	s.e.m *
	½ SI x ½ NDRS	½ BS x ½ NDRS		
Saturated (AGS)	54.78	55.98	ns	1.1625
C10:0 capric	0.51	0.58	ns	0.0394
C12:0 Lauric	0.93	0.67	ns	0.1551
C14:0 Myristic	6.00	5.87	ns	0.3608
C15:0 Pentadecyl	0.71	0.58	ns	0.0482
C16:0 Palmitic	32.60	34.70	ns	0.6767
C17:0 Heptadecanoic	1.03	0.95	ns	0.0448
C18:0 Stearic	12.99	12.63	ns	0.2844
Monosaturated	39.05	38.89	ns	0.5403
C14:1 Myristoleic	0.14	0.19	ns	0.0117
C16:1 Palmitoleic	1.91	2.35	ns	0.1025
C17:1 Heptoanoic	0.51	0.69	ns	0.0420
C18:1 Oleic	36.48	35.67	ns	0.5243
Polyunsaturated	5.02	3.67	0.04	0.2930
C18:2 Linoleic	3.83	2.99	ns	0.2886
C18:3 Linolenic	0.42	0.29	ns	0.0314
C18:2c9t11 (CLA)	0.77	0.31	0.04	0.1034
C20:4 Arachidonic	1.10	0.83	ns	0.0889

***s.e.m= standard error of the mean.**

explained by the influence of genetic groups, since, according to

De La Torre et al. (2006), the genetic group may influence the CLA content in ruminant meat. The isomer cis-9, trans-11, is characterized as more biologically active compound and constitutes about 80% of CLA in ruminant meat (Bolte et al. 2002). Meat from ruminant animals has the highest amount of CLA compared to other types of meat, ranging from 0.2 to 2.2% (Khanal & Olson 2004). Differences in individual concentrations of fatty acids may occur between breeds. An early genotype reaches maturity earlier and consequently has a higher rate of fat deposition (Maia et al. 2012).

About sensorial analysis, it was verified a higher intensity of meat color for lambs ½ BS x ½ NDRS (Table V). Thus, according to Gomes et al. (2011), the genetic factor and the advancement of the physiological maturity are factors that can modify meat color by deposition of pigments in muscular or adipose tissues and increasing myoglobin concentrations.

The meat color is most important quality factor that consumer can appreciate at time of purchase, constituting a basic criterion for choice (Zeola et al. 2010). Therefore, the meat of animals ½ BS x ½ NDRS presented a more appreciated color by the tasters at moment of sensorial analysis.

Acceptability of meat by consumers can be altered by fat levels and composition of fatty acids (Wood et al. 2008). Thus, it is worth noting that despite the higher fat content of

Table V. **Sensorial attributes of experimental lamb meat.**

Variable	Genotypes		Test F	s.e.m ˆ
	½ SI x ½ NDRS	½ BS x ½ NDRS		
Toughness	3.37	3.21	ns	0.2605
Juiciness	4.92	5.12	ns	0.2425
Flavor	5.51	5.68	ns	0.2828
Color	4.85	5.70	0.009	0.3492
Aroma	5.15	4.92	ns	0.3008
Overall appreciation	5.89	6.06	ns	0.2946

ˆ**s.e.m = standard error of the mean.**

meat the lambs ½ SB x ½ NDRS, there was no difference in the meat acceptability of both genetic groups evaluated (Table V). The average sensory attributes of meat, following the scale used were: slightly non-existent toughness, juiciness, flavor, color and moderate aroma. The overall acceptability was of moderately to highly acceptable, according to Stone et al. (1974).

The Genetic Group and the production system have varying effects on products of animal origin. Thus, the quantification of factors that may interfere with the lipid composition and the fatty acid profile of the final product, may direct the research on the production of foods that are beneficial to human health (Pessoa et al. 2016).

CONCLUSIONS

Considering the meat quality of the evaluated genetic groups, Santa Inês crossbred lambs have a better nutritional value for meat, especially taking into account the production of foods that are beneficial to human health.

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REFERENCES

AOAC - ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS. 2012. Official Methods of Analysis, 19th ed., Washington - DC, 3000 p.

ARRUDA PCL, PEREIRA ES, PIMENTEL PG, BONFIM MAD, MIZUBUTI IY, RIBEIRO ELA, FONTENELE RM & FILHO JGLR. 2012. Fatty acids profile in Longissimus dorsi of Santa Ines lambs fed with different energy levels. Semin Ciênc Agrár 33: 1229-1240.

BARBOSA NETO AC, OLIVEIRA SMP, OLIVARDO F & LÔBO RNB. 2010. Efeitos genéticos aditivos e não-aditivos em características de crescimento, reprodutivas e habilidade materna em ovinos das raças Santa Inês, Somalis Brasileira, Dorper e Poll Dorset. Rev Bras Zootec 39: 1943-1951.

BLIGH EG & DYERR WJ. 1959. A rapid method of total lipid extractionandpuri®cation. Can J Biochem Physiol 37: 911-917.

BOLTE MR, HESS BW, MEANS WJ, MOSS GE & RULE DC. 2002. Feeding lambs high-oleate or high-linoleate safflower seeds differentially influences carcass fatty acid composition. J Anim Sci 80: 609-616.

BUTTERFIELD RM, GRIFFTHS DA, THOMPSON JM, ZAMORA J & JAMES AM. 1984. Changes in body composition relative to weight and maturity of Australian Dorset Horn rams and wethers. 1. Carcass muscle, fat and bone and body organs. Anim Prod Sci 39: 251-258.

CAPPELLE ER, VALADARES FILHO SC, SILVA JFC & CECON PR. 2001. Estimativas do valor energético a partir de características químicas e bromatológicas dos alimentos. Rev Bras Zootec 30: 1837-1856.

CARTAXO FQ, SOUSA WH, CEZAR MF, COSTA RG, CUNHA MGG & GONZAGA NETO S. 2011. Características de carcaça determinadas por ultrassonografia em tempo real e pós-abate de cordeiros terminados em confinamento com diferentes níveis de energia na dieta. Rev Bras Zootec 40: 160-167.

CEZAR MF & SOUSA WH. 2007. Carcaças ovinas e caprinas: obtenção, avaliação e classificação, 1th ed., Uberaba: Editora Agropecuária Tropical, 232 p.

COSTA RG, SANTOS NM, SOUSA WH, QUEIROGA RCRE, AZEVEDO OS & CARTAXO FQ. 2011. Qualidade física e sensorial da carne de cordeiros de três genótipos alimentados com rações formuladas com duas relações volumoso:concentrado. Rev Bras Zootec 40: 1781-1787.

DE LA TORRE A, GRUFFAT D, DURAND D, MICOL D, PEYRON A, SCISLOWSKI V & BAUCHART D. 2006. Factors influencing proportion and composition of CLA in beef. Meat Sci 73: 258-268.

FOLCH J, LESS M & STANLEY S. 1957. A Simple method for the isolation and purification of total lipids from animal tissues. J Biol Chem 226: 497-509.

GOMES HFB, MENEZES JJL, GONÇALVES HC, CAÑIZARES GIL, MEDERIROS BL, NETO AP, LOURENÇO RV & CHÁVARI ACT. 2011. Características de carcaça de caprinos de cinco grupos raciais criados em confinamento. Rev Bras Zootec 40: 411-417.

KHANAL RC & OLOSN KC. 2004. Factors affecting conjugated linolec acid (CLA) contend in milk, meat and egg. Pak J Nutr 3: 82-98.

LEÃO AG, SILVA SOBRINHO AG, MORENO GMB, SOUZA HBA, PEREZ HL & LOUREIRO CMB. 2011. Características nutricionais da carne de cordeiros terminados com dietas contendo cana-de-açúcar ou silagem de milho e dois níveis de concentrado. Rev Bras Zootec 40: 1072-1079.

MAIA MO, COSTA FS, SUSIN I, RODRIGUES GH, FERREIRA EM, PIRES AV, GENTIL RS & MENDES CQ. 2012. Efeito do genótipo sobre a composição química e o perfil de ácidos graxos da carne de borregas. Rev Bras Zootec 41: 986-992.

MONTE ALS, GONÇALVES HRO, VILLARROEL ABS, DAMACENO MN & CAVALCANTE ABD. 2012. Qualidade da carne de caprinos e ovinos: uma revisão. ACSA 8: 11-17.

MORENO GMB, BUZZULINI C, BORBA H, COSTA AJ, LIMA TMA & DOURADO JFB. 2011. Efeito do genótipo e do teor de proteína da dieta sobre a qualidade da carne de cordeiros. Rev Bras Saúde Prod Anim 12: 630-640.

NRC - NATIONAL RESEARCH COUNCIL. 2007. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids. National Academic Press, Washington, DC, 362 p.

OSÓRIO MTM, BONACINA MS, OSÓRIO JCS, ROTA EL, FERREIRA OGL, TREPTOW RO, GONÇALVES MS & OLIVEIRA MM. 2013. Características sensoriais da carne de ovinos Corriedale em função da idade de abate e da castração. Rev Agrarian 6: 60-66.

PESSOA RMS, GOIS GC & CAMPOS FS. 2016. Fatores que interferem na composição lipídica dos tecidos muscular e adiposo em ruminantes. Semin Ciênc Agrár 17: 87-111.

RIBEIRO ELA, OLIVEIRA HC, CASTRO FAB, MIZUBUTIL IY, SILVA LDF & BARBOSA MAAF. 2010. Carcass and meat characteristics of crossbred lambs from three genetic groups. Semin Ciênc Agrár 31: 793-802.

SAS Institute. 2011. SAS/START user´s guide, release 9.3, ed. SAS Institute, Cary, NC.

SILVA LF, PIRES CC, ZEPPENFELD CC & CHAGAS GC. 2000. Crescimento de regiões da carcaça de cordeiros abatidos com diferentes pesos. Ciênc Rural 30: 481-484.

STONE H, SIDEL JL, OLIVER S, WOOSLEY A & SINGLETON RC. 1974. Sensory evaluation by quantitative descriptive analysis. Food Technol 28: 24-34.

VAN SOEST PJ, ROBERTSON JB & LEWIS BA. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polyssacharides in relation to animal nutrition. J Dairy Sci 74: 3583-3597.

WOOD JD, ENSER M, FISHER AV, NUTE GR, SHEARD PR, RICHARDSON RI, HUGHES SI & WHITTINGTON FM. 2008. Fat deposition, fatty acid composition and meat quality: A review. Meat Sci 78: 343-358.

ZEOLA NMBL, SOUZA PA, SOUZA HBA & SILVA SOBRINHO AG. 2010 Características sensoriais da carne de cordeiro maturada e injetada com cloreto de cálcio. Arch Zoot 59: 539-548.

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Author contributions

Delano de Sousa Oliveira performed the experiment;
Delano de Sousa Oliveira and Marcos Cláudio Pinheiro Rogério worked out almost all of the technical details, and performed the numerical calculations for the suggested experiment;
Delano de Sousa Oliveira, Marcos Cláudio Pinheiro Rogério, Arnaud Azevêdo Alves, Fernando Henrique Melo Andrade Rodrigues, Roberto Cláudio Fernandes Franco Pompeu, Vinícius Pereira Guimarães were involved in planning and supervised the work; Ana Sancha Malveira Batista supervised sensory analysis of the meat; All authors provided critical feedback and helped shape the research, contributed to the research and the analysis of the results and discussed the results and contributed to the final manuscript.