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CARACTERIZACIÓN MORFOLÓGICA, DE LA CANAL Y DE LA CARNE, E INFERENCIA DE MATERNIDADES EN OVINOS DE RAZA RIPOLLESA

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El trabajo de investigación "**Caracterización morfológica, de la canal y de la carne, e inferencia de maternidades en ovinos de raza Ripollesa**'' ha sido realizado por Cecilia Esquivelzeta Rabell[1] y se presenta como requisito para optar por el grado de Doctor.

Bellaterra, veinticinco de mayo de dos mil doce.

Los directores de Tesis, La doctoranda,

Dr. Jesús Piedrafita Arilla y Dr. Joaquim Casellas Vidal Cecilia Esquivelzeta Rabell

[1] Beca del Consejo Nacional de Ciencia y Tecnología, México (CONACyT).

Gracias a todos los que han estado presentes y me han ayudado de alguna u otra forma a alcanzar esta meta, jamás encontraré la forma de agradecer su apoyo y confianza.

RESUMEN

Para poder implementar programas de mejora genética en el sector ovino de carne, es imprescindible definir y evaluar los caracteres biológicos con relevancia económica en la producción. Es por ello que la caracterización morfológica de la raza ovina Ripollesa, la diferenciación entre rebaños, la utilización de metodologías analíticas para evitar pérdida de información relevante y el estudio de las características de la canal y de la carne, se definieron como objetivos del presente trabajo.

La raza ovina Ripollesa es una importante raza autóctona Española localizada principalmente en las montañas del Mediterráneo y en llanuras cultivadas de Cataluña, explotada bajo sistemas semi-extensivos de producción y actualmente destinada a la producción de carne. La caracterización morfológica de la raza Ripollesa se llevó a cabo a partir del estudio de ocho rebaños representativos de diferentes subpoblaciones históricas. Un total de 224 hembras Ripollesas y 17 moruecos fueron caracterizados registrando su peso vivo y 12 medidas morfológicas, las cuales fueron utilizadas para el cálculo de 12 índices zoométricos. Se encontraron diferencias ($p < 0.05$) entre rebaños y sexos respecto a varias medidas. El análisis de componentes principales realizado con las medidas morfológicas reveló dos componentes principales que contribuyen con 47,6% y 12,3% de la inercia, estando relacionados con el tamaño (tamaño corporal y peso vivo) y con la altura a la grupa y longitud de oreja, respectivamente. El análisis de cluster nos permitió diferenciar cuatro subpoblaciones con implicaciones relevantes a ser tomadas en cuenta en el programa de conservación o mejora de la raza. Las diferencias observadas pueden atribuirse a la localización geográfica, historia selectiva, manejo del rebaño, y las diferencias genéticas. Los índices zoométricos indican que la raza ovina Ripollesa es de tamaño medio y longilínea, con una marcada orientación a la producción de carne y con signos de adaptación al ambiente.

En los rebaños ovinos, la correcta identificación de los progenitores presenta a menudo problemas debidos a la presencia de varios candidatos posibles tanto por vía paterna como materna. Un ejemplo típico en donde las paternidades deben de ser

elucidadas a partir de una lista de moruecos es en sistemas reproductivos con múltiples machos, generalmente bajo condiciones extensivas de pastoreo. La misma situación ocurre por la vía materna cuando se producen múltiples nacimientos en el mismo día y uno o varios de los corderos no son adoptados por sus madres respectivas. Este fenómeno conlleva a un porcentaje entre moderado y bajo de corderos con pedigrí incompleto, con la consiguiente pérdida de información para el programa de mejoramiento genético. Debido a las restricciones económicas inherentes de la industria ovina, el genotipado sistemático de todos los corderos abandonados no es económicamente viable para los productores y sólo un número reducido de corderos abandonados podrían ser validados por medio de esta técnica. Dentro de este contexto, se adaptó un modelo Bayesiano para identificar la madre en el caso de corderos abandonados, integrando fuentes de información tanto genéticas como medioambientales de datos fenotípicos, y así considerar la oveja desconocida como un parámetro adicional del modelo. Éste fue minuciosamente evaluado utilizando datos de simulación y asumiendo siete escenarios diferentes en donde de uno a cuatro corderos abandonados tenían que ser asignados a dos ovejas candidatas. La media general de la probabilidad de asignación materna correcta (PARD) fue 0,59. Aunque las medias de PARD oscilaron entre 0,51 y 0,70 dependiendo del escenario de simulación, y las estimaciones de PARD oscilaron entre 0,04 y 1,0. En un sentido similar, la sensibilidad de esta metodología analítica varió entre escenarios de simulación, aunque la mayoría de ellos revelan valores mayores que 0,6. La presente aproximación analítica debe ser vista como una herramienta estadística útil para realizar una proyección preliminar de los corderos abandonados y sus posibles madres. Es importante subrayar que cualquier inferencia en maternidades desconocidas podría reducir consecuentes costos económicos permitiendo enfocar el genotipado en aquellos corderos con mayor probabilidad de ser descendientes de ovejas élite.

La preocupación e importancia que ha tomado la composición de los alimentos y su relación con la salud humana durante las últimas décadas ha sido un punto clave para la industria ovina actual, enfatizando el interés y la importancia por parte de los productores para poder predecir las características de la canal y conocer las propiedades

de sus productos. Las técnicas de ultrasonido a tiempo real resultan de gran utilidad para predecir las características de la canal en el animal vivo de manera no invasiva. Con el objetivo de evaluar la precisión de las medidas de ultrasonido para predecir las características de la canal, se tomaron imágenes de ultrasonido en 124 corderos pascuales (13-16 kg de peso a la canal), transversal y longitudinalmente a la columna vertebral, y a nivel torácico (TV; entre la 12 ª y 13ª costillas) y lumbar (LV; entre la 1ª y 2ª vértebra lumbar). El grosor de la piel, grosor de la grasa subcutánea (BFT), y profundidad (DLD), amplitud (WLD) y área (ALD) del músculo *Longissimus dorsi* fueron obtenidos con ayuda del programa ImageJ 1.42q. Después del sacrificio, BFT (TV, 2,30 ± 0,06 mm; LV, 2,46 ± 0,06 mm), DLD (2,47 ± 0,03 cm; 2,48 ± 0,03 cm), WLD (4,50 ± 0,04 cm; 4,60 ± 0,04 cm) y ALD (9,96 ± 0,12 cm^2; 10,19 ± 0,13 cm^2) fueron medidos directamente sobre la canal del cordero. Las correlaciones entre las medidas de ultrasonido y de la canal fueron superiores a 0,61 para DLD, WLD y ALD ($p < 0.05$), mientras que fluctuaron entre 0,32 y 0,60 para BFT ($p < 0,05$); por otra parte, las correlaciones fueron significativamente ($p <$ 0,05) mayores para las vistas transversales que para las longitudinales. En un sentido similar, los análisis de regresión lineal sugirieron una moderada subestimación para BFT y DLD lumbar utilizando tecnologías de ultrasonido, mientras que WLD, ALD y DLD a nivel torácico fueron sub y sobreestimadas para valores pequeños y grandes de caracteres de la canal, respectivamente. Después de descomponer el error de predicción (MSPE) para las diferentes medidas de ultrasonido, encontramos que el error aleatorio es el que más contribuye al MSPE, seguido del error de tendencia central y el error debido a la regresión. El error estándar de la predicción (SEP) también fue calculado como un indicador de precisión adicional, obteniendo estimaciones inferiores a las reportadas en estudios previos con corderos más grandes. En conclusión, las medidas de ultrasonido transversales tanto a nivel torácico como lumbar pueden ser una herramienta útil para predecir DLD, WLD y ALD en corderos ligeros, y en menor medida BFT. Esta información puede ser de relevancia especial para productores de corderos ligeros de todo el mundo, con un énfasis especial en la zona del Mediterráneo en donde este tipo de sistemas de producción contribuyen con un porcentaje importante a la industria ovina.

La carne de cordero es una fuente importante de diferentes ácidos grasos con numerosos beneficios para la salud del consumidor. El objetivo del cuarto estudio fue caracterizar caracteres de la canal y de la carne en 14 corderos pascuales (peso a la canal, 13 a 16 kg) Lacaune, 77 Ripolleses y 33 cruzados Lacaune×Ripollesa utilizando medidas de ultrasonido y de la canal, y análisis de laboratorio de las muestras de carne. Específicamente, se tomaron imágenes de ultrasonido y medidas sobre la canal del *Longissimus dorsi* (LD) entre la 12ª y 13ª costillas y entre la 1ª y 2ª vértebras torácicas, caracterizando el grosor de la piel, grosor de grasa subcutánea, y profundidad, amplitud y área del LD. Después del sacrificio, se tomaron los pesos de las diferentes partes del despiece comercial de la canal (i.e., pierna, costillar, espalda y cuello), mientras que una muestra del músculo LD fue analizada para composición de ácidos grasos. Las medidas de ultrasonidos y canal no difirieron significativamente entre razas, siendo 0,16 ± 0,004 cm y 0,23 ± 0,01 cm para BFT, 2,40 ± 0,02 cm y 2,47 ± 0,03 cm para DLD, 4,53 ± 0,05 cm y 4,50 ± 0,04 cm para WLD, y 9,79 ± 0,11 cm^2 y 9,97 ± 0,12 cm^2 para ALD, respectivamente. El rendimiento a la canal fue mejor en la raza Lacaune seguido de la Ripollesa ($p < 0,05$); los pesos del despiece comercial no mostraron diferencias significativas, aunque también estaban correlacionados (0,2-0,4) con las medidas de ultrasonidos. El análisis de ácidos grasos (FA) mostró que los FA mayormente representados en el tejido muscular fueron: oleico (C18:1n-7, 38,8%) siendo mayor para Lacaune, palmítico (C16:0, 21,7%) sin diferencias entre razas, y esteárico (C18:0, 14.3%) con menor porcentaje para Lacaune. Se encontraron diferencias entre razas ($p < 0,05$) para los porcentajes de FA saturados (SFA; 39.0-41.2%), monoinsaturados (MUFA; 48.1-49,6%) y poliinsaturados (PUFA; 6,0-7,5%). En cuanto a la proporciones para parámetros nutricionales, solo se encontraron diferencias ($p < 0,05$) para la proporción PUFA/SFA, siendo mayor para la raza Lacaune (0,19), seguido por la Ripollesa (0,16) y los individuos cruzados (0,15). Los valores nutricionales para n-6/n-3 variaron desde 6,27 a 6,96, y desde 7,85 a 8,57 para C18:2 n-6/C18:3 n-3. Toda esta información es esencial para los productores de cordero ligero, un producto ganadero que tiene una alta demanda en el mercado Mediterráneo.

SUMMARY

To be able to implement genetic selection programs in meat-producing sheep breeds, it is essential to define and evaluate biological traits with economic relevance in the production system. Within this context, the morphologic characterization of the Ripollesa sheep breed, the differences between flocks, the use of analytical methodologies to avoid the loss of relevant pedigree data, and the study of carcass and meat trais, were defined as objectives of the present work.

The Ripollesa sheep breed is an important Spanish local breed mainly located in the Mediterranean mountains and cultivated plains of Catalonia, exploited under semi-extensive production systems and currently intended for meat production. The morphologic characterization of the Ripollesa breed was carried out from the study of 8 flocks representative of different subpopulations. A total of 224 Ripollesa ewes and 17 rams were recorded for their live-weight and 12 morphological measures, which were used for calculating 12 zootechnical indexes. Differences ($p < 0.05$) between flocks and sexes were revealed for several measures. A principal component analysis was performed on the morphological measures and revealed two main components accounting for 47.6% and 12.3% of the inertia, being related to the frame (body size and live-weight) and to withers height and ear length, respectively. The cluster analysis allowed differentiating among four subpopulations with relevant implications to be taken into account for the breed conservation program. The observed differences could be attributable to geographic location, selective history, flock management, and genetics. The estimated zootechnical indexes classified the Ripollesa sheep breed as a medium-sized and long-shaped body frame, with a marked orientation to meat production and with signs of adaptation to the environment.

In sheep flocks, lamb's parents can be misidentified or confounded due to the plausibility of two or more potential sires or dams. A typical example where paternities must be elucidated from a list of several candidate sires is in multiple-sire mating systems under pastoral conditions. The same situation occurs when two or more ewes gave birth

the same day and one or more lambs are not adopted by its corresponding mother. This phenomenon leads to a moderate-to-low percentage of lambs with missing pedigrees, with the subsequent loss of information for the corresponding selection schemes. Given the economic restrictions inherent to the sheep industry, systematic genotyping of all abandoned lambs is not affordable by stockbreeders and only a much reduced number of lambs could be validated by this technique. Within this context, we adapted a Bayesian model to ascertain the dam of abandoned lambs by integrating both genetic and environmental sources of information from phenotypic data and modeling the uncertain dam as an additional unknown parameter. The model performance was thoroughly evaluated by using simulation data and by assuming seven different scenarios where one to four abandoned lambs had to be assigned to two candidate ewes. The overall average probability of assignment to the right dam (PARD) was 0.59, although PARD averages ranged between 0.51 and 0.70 depending on the simulation scenario, and raw PARD estimates ranged between 0.04 and 1.0. In a similar way, sensitivity of this analytical methodology varied across simulation scenarios, although most of them revealed values larger than 0.6. This analytical approach must be viewed as a useful statistical tool for performing preliminary screenings on abandoned lambs and their candidate dams. Note that any inference on uncertain dams would reduce further economic costs by focusing genotyping efforts on those lambs with higher probabilities to be offspring from elite ewes.

Concern about meat composition and its relationship with human health has increased during the last few decades has been a key point for the actual sheep farming industry, emphasizing the interest and importance for producers to be able to predict carcass traits and know the properties of their products. Real-time ultrasound techniques are of great utility to predict carcass characteristics in the live animal in a non-invasive way. With the aim to assess the accuracy of the ultrasound measurements for predicting carcass traits, ultrasound images were taken in 124 Spanish 'pascual'-type lambs (13 to 16 kg of carcass weight), transversal and longitudinal to the vertebral column, and at thoracic (TV; between 12th and 13th ribs) and lumbar (LV; between 1st and 2nd lumbar vertebrae) locations. Skin thickness, subcutaneous back-fat thickness (BFT), and depth

(DLD), width (WLD) and area (ALD) of *Longissimus dorsi* were obtained by the ImageJ 1.42q software. After slaughtering, BFT (TV, 2.30 ± 0.06 mm; LV, 2.46 ± 0.06 mm), DLD (2.47 ± 0.03 cm; 2.48 ± 0.03 cm), WLD (4.50 ± 0.04 cm; 4.60 ± 0.04 cm) and ALD (9.96 ± 0.12 cm^2; 10.19 ± 0.13 cm^2) were directly measured on the lamb carcass. Correlations between ultrasound and direct carcass measurements were larger than 0.61 for DLD, WLD and ALD ($p < 0.05$), whereas they fluctuated between 0.32 and 0.60 for BFT ($p < 0.05$); moreover, correlations were significantly ($p < 0.05$) higher for transversal than for longitudinal views. In a similar way, linear regression analyses suggested a moderate underestimation for BFT and lumbar DLD when using real-time ultrasound technologies, whereas WLD, ALD and thoracic DLD suffered from under- and over-estimation for small and large values of carcass traits, respectively. After decomposing the error of prediction (MSPE) for the different ultrasound measurements, we found that the error due to disturbance contributed most to the MSPE, followed by the error of central tendency and the error due to regression. The standard error of prediction (SEP) was also calculated as an additional precision indicator, obtaining estimates lower than that in previous studies with larger lambs. In conclusion, transversal ultrasound measurements at both thoracic and lumbar levels could be a useful tool for predicting DLD, WLD and ALD in light lambs, perhaps suffering from worse prediction properties when focusing on BFT. This information could be of special relevance for light lamb producers worldwide, with a special emphasis in the Mediterranean basin where this kind of production system accounts for an outstanding percentage of the sheep industry.

Lamb meat is an important source of different fatty acids with numerous health benefits for the consumer. The aim of the fourth study was to characterize carcass and meat traits in 14 Lacaune, 77 Ripollesa and 33 Lacaune×Ripollesa ‘pascual’-type lambs (carcass weight, 13 to 16 kg) by using ultrasound and direct measurements on carcasses and laboratory analyses on meat samples. More specifically, ultrasound images and direct carcass measurements of the *Longissimus dorsi* (LD) were taken between the 12th and 13th ribs and between the 1st and 2nd lumbar vertebrae, characterizing skin thickness, subcutaneous back-fat thickness, and depth, width and area of LD. After slaughter, standard commercial joints were weighted (i.e., leg, rack, shoulder/foreshank and neck),

whereas a sample of the LD muscle was analyzed for fatty acid composition. They were not found significant differences between breeds for ultrasound and carcass measures, being 0.16 ± 0.004 and 0.23 ± 0.01 cm for GSC, 2.40 ± 0.02 and 2.47 ± 0.03 cm for PM. 4.53 ± 0.05 and 4.50 ± 0.04 cm for AM, and 9.79 ± 0.11 and 9.97 ± 0.12 cm^2 for ARM, respectively. Carcass yield was better for Lacaune followed by Ripollesa; weight of carcass pieces did not show significant differences but were also correlated (0.2-0.4) with ultrasonic measurements. The meat fatty acid (FA) analysis showed that the FA mostly represented in muscular tissue under examination were: oleic (C18:1n-7, 38.8%) being greater for L sheep breed, palmitic (C16:0, 21.7%) without differences between breeds, and stearic (C18:0, 14.3%) lower percentage for L breed. Differences between breeds for saturated (SFA; 39.0-41.2%), monounsaturated (MUFA; 48.1-49.6%) and polyunsaturated FA (PUFA; 6.0-7.5%) proportions were found. Differences for nutritional ratios were only found for PUFA/SFA ratio, being greater for L breed (0.19), followed by R (0.16) and RL (0.15) breeds. Nutritional ratios for n-6/n-3 varied from 6.27 to 6.96 and from 7.85 to 8.57 for C18:2 n-6/C18:3 n-3 ratio. All of this information becomes essential for light lamb producers, a livestock product that has high market demand in the Mediterranean basin.

ÍNDICE

ÍNDICE DE FIGURAS

CAPÍTULO 1. Introducción

CAPÍTULO 3. Revisión bibliográfica

CAPÍTULO 4. Characterization of the Ripollesa breed

CAPÍTULO 5. Bayesian inference of maternities

CAPÍTULO 6 Real-time ultrasounds in light lambs

ÍNDICE DE TABLAS

CAPÍTULO 1 Introducción

CAPÍTULO 3. Revisión bibliográfica

CAPÍTULO 4. Characterization of the Ripollesa breed

CAPÍTULO 5. Bayesian inference of maternities

CAPÍTULO 6. Real-time ultrasounds in light lambs

CAPÍTULO 7. Carcass traits and meat composition in light lambs

Capítulo 1

INTRODUCCIÓN

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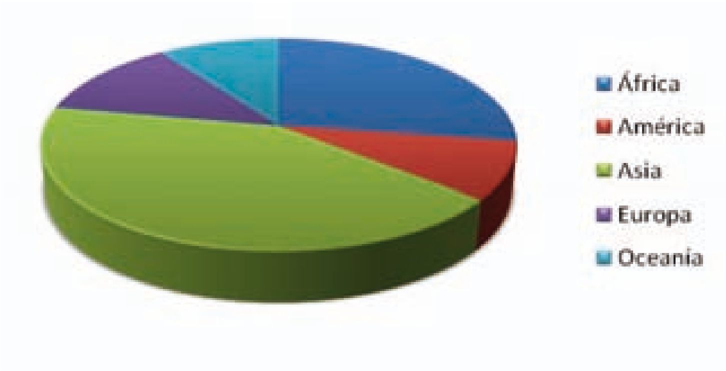
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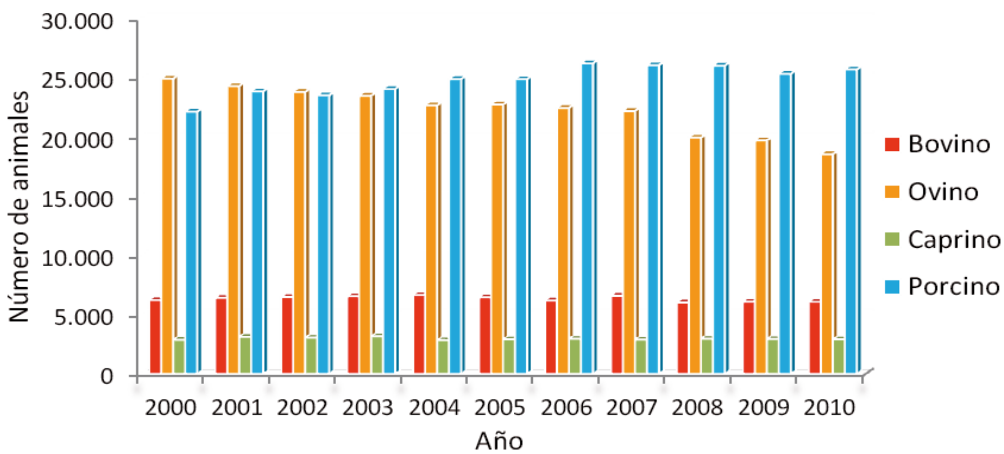
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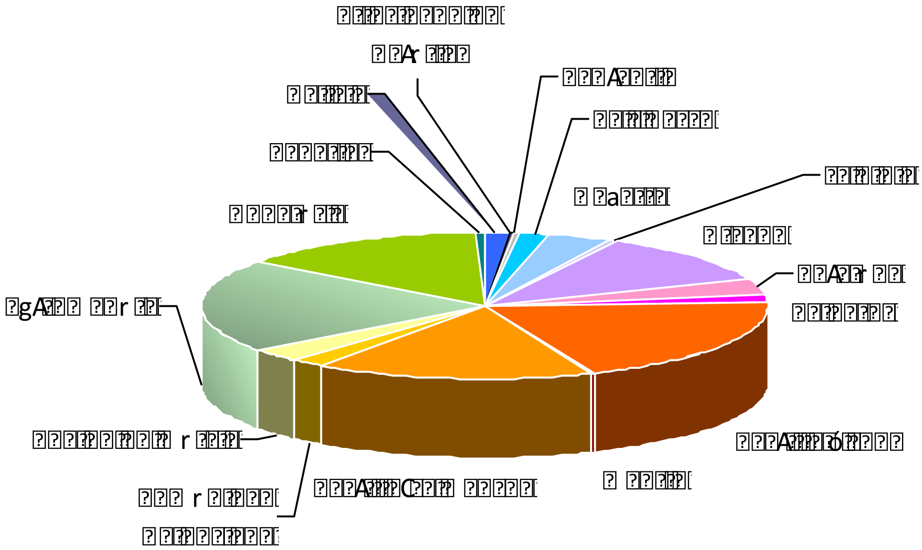

Tabla 1.2 Distribución del número de ovinos según tipo productivo en las comunidades autónomas españolas (MAPA, 2010).

Provincias y comunidades autónomas	Total	Corderos	Moruecos	Hembras para vida					
				Total	Nunca han parido			Que ya han parido	
					No cubiertas	Cubiertas por primera vez		Ordeño	No Ordeño
						Ordeño	No ordeño		
Galicia	234.104	18.730	11.348	204.026	3.017	7	10.378	1.300	189.324
Asturias	56.938	1.252	3.448	52.238	2.213	225	5.264	900	43.636
Cantabria	74.416	9.242	2.416	62.758	6.951	135	4.722	1.061	49.889
País Vasco	324.223	16.435	10.524	297.264	42.385	25.778	20.016	118.755	90.330
Navarra	646.799	85.389	13.361	548.049	21.111	22.752	29.609	131.534	343.044
La Rioja	127.260	15.448	2.252	109.561	2.710	355	5.976	2.881	97.639
Aragón	2.052.438	339.413	37.457	1.675.569	133.679	1.106,59	157.387	10.649	1.372.747
Cataluña	638.804	150.657	11.667	476.480	34.163	30	27.096	150	415.040
Baleares	341.463	63.629	9.147	268.687	8.068	486	21.056	1.428	237.649
Castilla y León	3.573.539	354.621	62.647	3.156.270	265.605	179.579	68.397	1.251.262	1.391.428
Madrid	91.812	9.625	2.442	79.745	6.823	4.268	3.792	36.186	28.675
Castilla la Mancha	2.936.263	606.555	60.653	2.269.055	141.937	104.289	51.168	912.905	1.058.755
C. Valenciana	365.174	61.153	7.940	296.081	16.338	151	21.543	0	258.048
R. de Murcia	527.896	128.911	14.475	384.510	22.958	0	17.593	0	343.959
Extremadura	3.809.398	657.899	97.572	3.053.927	112.723	14.777	99.594	248.321	2.578.512
Andalucía	2.670.810	347.159	75.966	2.247.685	174.402	4.690	86.267	41.871	1.940.454
Canarias	80.304	4.342	2.789	73.172	6.520	4.332	5.224	20.218	36.878
España	18.551.642	2.870.461	426.105	15.255.076	1.001.604	362.961	635.082	2.779.421	10.476.007

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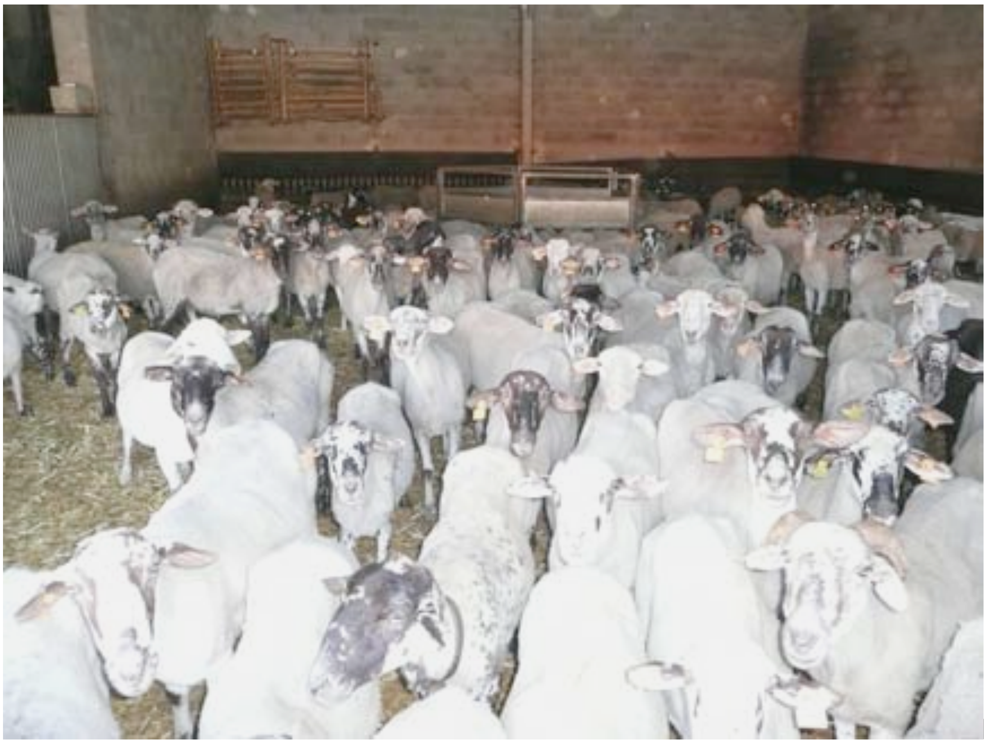

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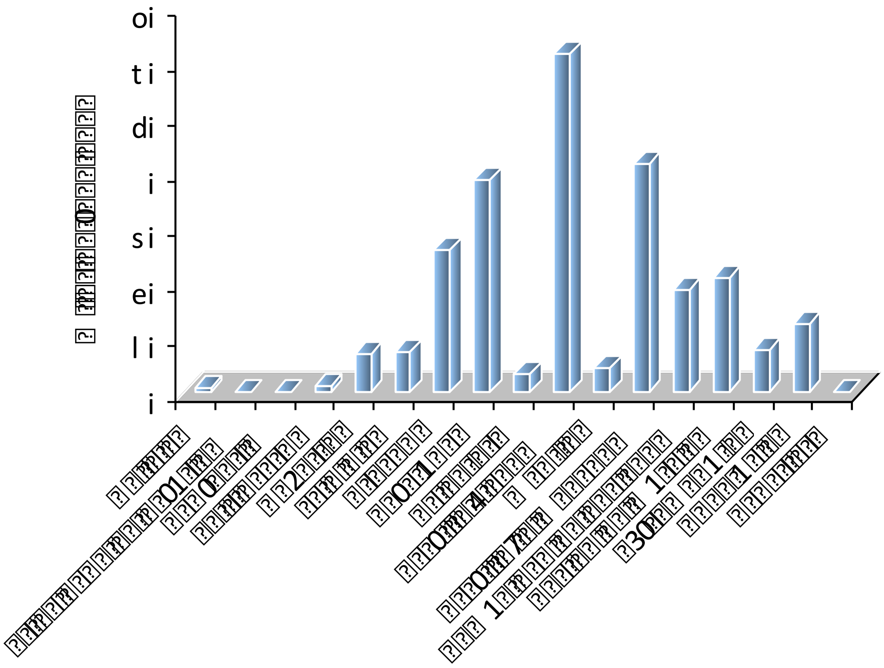

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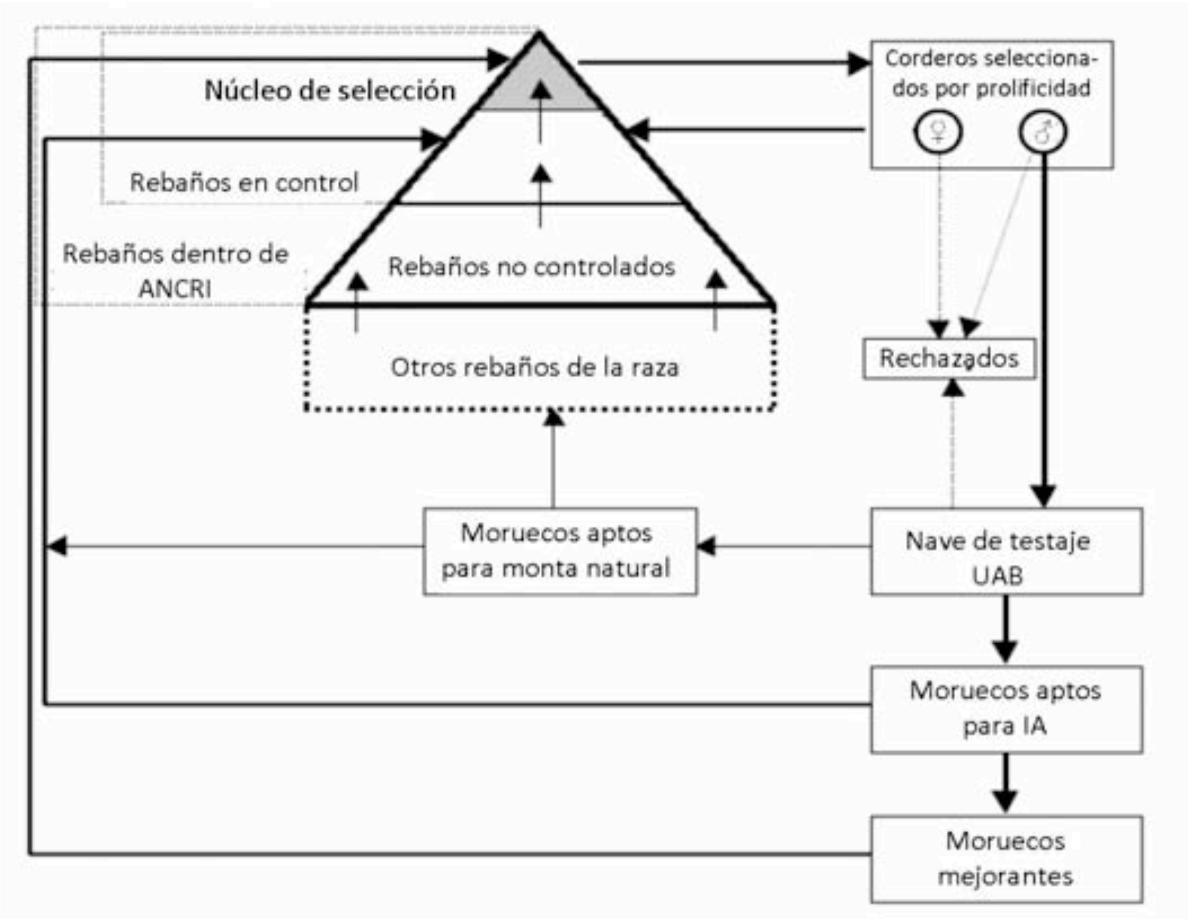
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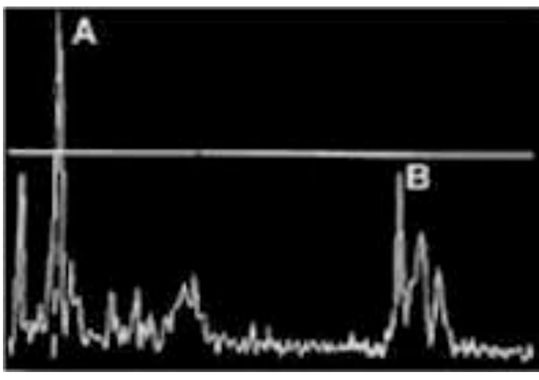
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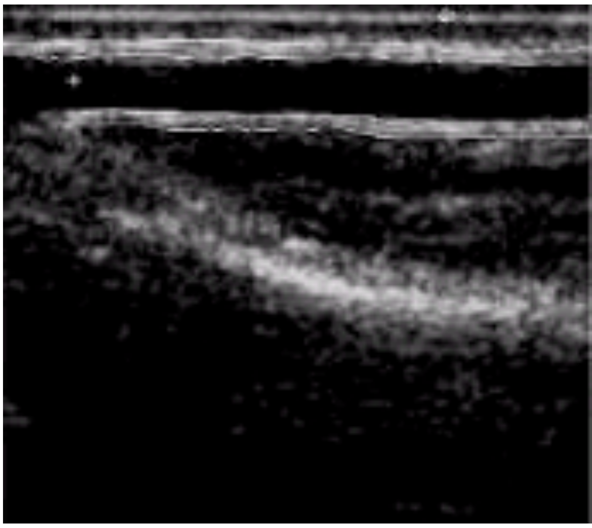

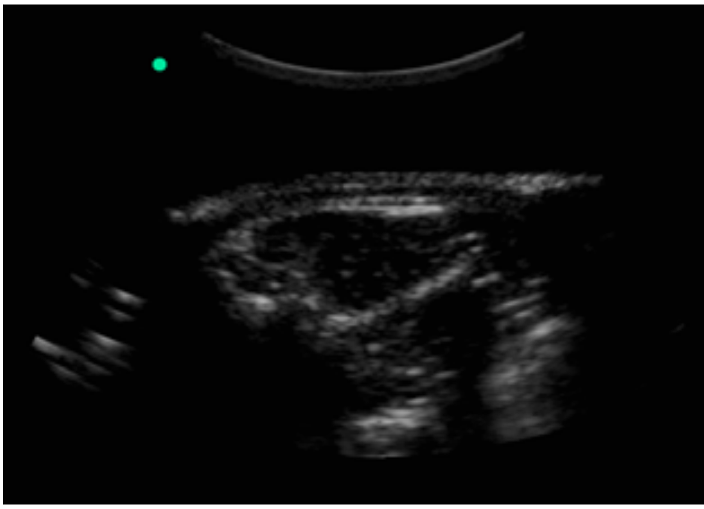

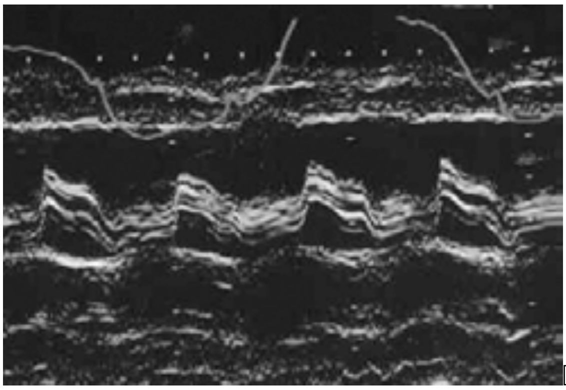

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Tabla 3.2 Clasificación de la canal ovina respecto a su conformación (Reglamento CEE 1278/94).

Clase de conformación	Descripción	Cuartos traseros	Lomo	Paletilla
S - superior	Todos los perfiles muy convexos; desarrollo muscular excepcional con grupa doble	Con doble musculatura	Extremadamente convexo, ancho y grueso	Extremadamente convexa y gruesa
E - excelente	Todos los perfiles de convexos a muy convexos; desarrollo muscular excepcional	Muy gruesos, perfiles muy convexos	Muy convexo, ancho y grueso hasta la paletilla	Muy convexa y gruesa
U - muy buena	Perfiles convexos en conjunto; fuerte desarrollo muscular	Gruesos, perfiles convexos	Ancho y grueso hasta la paletilla	Gruesa y convexa
R - buena	Perfiles rectilíneos en conjunto; buen desarrollo muscular	Perfiles generalmente rectilíneos	Grueso pero menos ancho hasta la paletilla	Bien desarrollada pero menos gruesa
O - menos buena	Perfiles rectilíneos a cóncavos; desarrollo muscular medio	Perfiles con tendencia a ser ligeramente cóncavos	Escasa anchura y grosor	Con tendencia a ser estrecha, escaso grosor
P - inferior	Perfiles cóncavos a muy cóncavos; escaso desarrollo muscular	Perfiles cóncavos a muy cóncavos	Estrecho y cóncavo, con los huesos aparentes	Estrecha, plana y con los huesos aparentes

Tabla 3.3 Clasificación de las canales ovinas respecto al grado de engrasamiento (Reglamento CEE 1278/94).

Clase de cobertura grasa	Descripción	Externa	Interna	
			Abdominal	Torácica
1 – muy escasa	Cobertura grasa inexistente o muy ligera	Presencia escasa o nula de grasa	Presencia escasa o nula de grasa en los riñones	Presencia escasa o nula de grasa entre las costillas
2 – escasa	Cobertura grasa ligera, carne casi siempre aparente	Canal cubierta por una capa fina de grasa, menos apreciable en los miembros	Riñones con presencia escasa de grasa o cubiertos parcialmente por una capa muy fina de grasa	Músculos claramente visibles entre las costillas
3 – media	Músculos, con excepción de los cuartos traseros y la paletilla, casi siempre cubiertos de grasa; pequeños cúmulos de grasa en la cavidad torácica	Una capa fina de grasa cubre toda la canal o la mayor parte de la misma; zonas de grasa ligeramente más espesa en la zona del rabo	Una capa fina de grasa cubre total o parcialmente los riñones	Músculos aún visibles entre las costillas
4 – importante	Músculos cubiertos de grasa pero aún parcialmente visible en los cuartos traseros y la paletilla; cúmulos apreciables de grasa en la cavidad torácica	Una capa espesa de grasa cubre toda la canal o la mayor parte de la misma, aunque puede ser más delgada en los miembros y más espesa en las paletillas	Riñones cubiertos de grasa	Los músculos entre las costillas pueden presentar infiltraciones de grasa, depósitos de grasa en las costillas
5 – muy importante	Canal cubierta por completo de grasa espesa; importantes cúmulos de grasa en la cavidad torácica	Cobertura grasa muy espesa, pueden ser visibles cúmulos de grasa	Riñones cubiertos de una capa espesa de grasa	Músculos intercostales con infiltraciones de grasa, se aprecian depósitos de grasa en las costillas

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Capítulo 4

CHARACTERIZATION OF THE RIPOLLESA BREED

Morphologic analysis and subpopulation characterization of Ripollesa sheep breed

Introduction

Livestock farming based on local breeds constitutes a very valuable animal industry from the economic, social and environmental points of view. Local breeds have remarkable special characteristics like resistance to prevailing diseases, fertility, maternal ability, longevity, adaptation to the environment and unique attributes of their final products, among others (García, 1980). Nevertheless, the increasing demand for animal products has led to an intensification of production systems and the subsequent restriction of the livestock industry to a few specialized breeds. This practice has reduced the use of local breeds and put their survival in danger (Oldenbroek, 1999), which is also the case of the Ripollesa breed. To overcome this problem, the Food and Agriculture Organization (FAO; http://www.fao.org) of the United Nations recommended establishing conservation programmes for the maintenance of animal genetic resources. Note that these programmes include, among other actions, the characterization of these local breeds.

Most of the native breeds of Spain included in the inventory of Spanish livestock breeds belong to the ovine species (Spanish Real Decreto 2129/2008, http://www.boe.es/boe/dias/2009/01/27/pdfs/BOE-A-2009-1312.pdf). The Ripollesa is the most abundant local sheep breed in Catalonia (Milán, Arnalte and Caja, 2003; Caja et al., 2010), an Autonomous Community located in the NE of Spain. The breed is usually considered as being moderately prolific and is exploited for the production of “pascual”-type lambs (Guillaumet and Caja, 2001; Caja et al., 2010). Indeed, previous studies reported both appealing productive (Torre et al., 1989; Torre, 1991; Casellas et al., 2007c) and reproductive (Casellas et al., 2007a, 2007b) performance within the context of a remarkable adaptability to the geoclimatic conditions of the Mediterranean area (Guillaumet and Caja, 2001). Nevertheless, additional efforts to typify this breed become necessary, given that there is a substantial phenotypic heterogeneity that could even lead to different subpopulations (Torre, 1991).

Although the existence of different Ripollesa subpopulations was advocated by stakeholders for decades and suggested by different authors (Torre, 1991; Guillaumet and Caja, 2001), this hypothesis has never been tested. If true, this breed could suffer from a severe genetic structure (bottleneck) with important consequences on its effective population size and, by extension, on its conservation or even selection programme. These hypothetical subpopulations may have originated in different geographic areas and could differ in both, production and morphological traits, the latter being the main objective of our study.

In the present work, an attempt has been made to characterize the morphologic diversity of the Ripollesa sheep breed, both between and within flocks. This research was performed on the basis of standardized morphological measurements and the subsequent calculation of zootechnical (ethnological and functional) indexes.

Material and Methods

The Ripollesa breed

The Ripollesa sheep were described as a medium-sized breed with convex profile and characteristic pigmentation with black or brown spots on the head and legs (Sánchez-Belda and Sánchez-Trujillano, 1986; Guillaumet and Caja, 2001; Caja et al., 2010). This breed belongs to the Spanish medium-fine (i.e., “entrefino”) wool-type trunk with white wool and packed fleece (wool fibre diameter, 23 to 26 µm; Sánchez-Belda and Sánchez-Trujillano, 1986) (Figure 4.1). The breed is characteristically Mediterranean exploited under semi-extensive production systems in the mountains and cultivated plains of Catalonia and currently intended for meat production (Guillaumet and Caja, 2001; Caja et

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(4) Queralpina, from Queralbs (Girona), smaller and less prolific sheep with longer and the finest wool fibres.
(5) Hilarenca, from Sant Hilari Sacalm (Girona), the largest rams with long horns and presence of abundant hair in the wool in rams and ewes. Lambs are markedly hairy at birth.

Main differences among subpopulations should be expected with regard to body size and characteristics of wool and horns (Guillaumet and Caja, 2001).

Sheep samples

Morphological measurements were taken between September 2007 and June 2008, on adult Ripollesa animals (more than two years old) belonging to eight flocks registered in the official Flock-Book of the breed. Flocks were distributed across the geographic areas where the Ripollesa sheep are located (Figure 4.2), providing samples from the subpopulations described by Torre (1991) (Table 4.1).

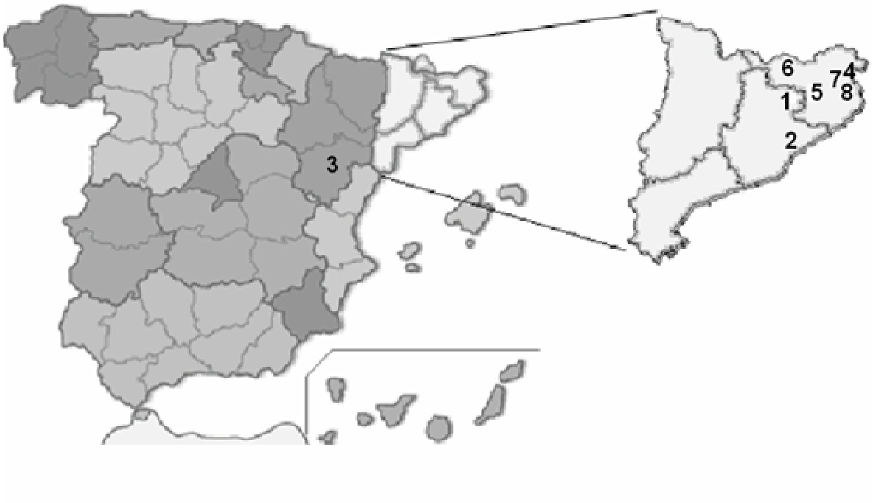
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Table 4.1 Description of the flocks and number of animals measured in each flock.

Flock	Flock location (village and province)	Subpopulation†	Flock size	Number of ewes measured	Number of rams measured
Cal Terrisco	Olost, Barcelona	Lluçanenca	550	30	--
SGCE	Bellaterra, Barcelona	Igualadina	140	29	4
Parras de Martín	Las Parras de Martín, Teruel	Igualadina	950	29	2
Mas Muxach	L'Estartit, Girona	Hilarenca and Gósolenca	438	27	3
Montseny	Osor, Girona	Hilarenca	610	24	4
Cal Sabaté	Nevà, Girona	Hilarenca and Queralpina	820	30	--
Mas Ros	Les Olives, Girona	Queralpina	964	27	2
SEMEGA	Monells, Girona	Queralpina	45	28	2

† The original types described in previous manuscripts were *Gósolenca*, *Igualadina*, *Queralpina* and *Hilarenca* (Torre, 1991; Guillaumet and Caja, 2001; Torres, 2007).

Morphological measurements

Morphological variables were measured by the same trained operator in the mornings, before the animals left the shelter to graze to avoid undesirable variations due to changes in live-weight and rumen volumes. On the basis of Aparicio (1944), the following 12 morphological measures were taken on each animal (Figure 4.3):

(1) head length (HL), frontal distance from mouth to poll,
(2) head width (HW), maximum distance between zygomatic arches,
(3) ear length (EL), distance from the base to the tip of the right ear, along the dorsal surface,
(4) chest depth (CD), vertical distance from the top of the withers to the xyfoid process of the sternum,
(5) chest width (CW), maximum intercostal diameter at the level of the 6th rib, just behind the elbows,
(6) chest girth (CG), perimeter of the chest at the level of the 6th rib,
(7) withers height (WH), height from the top of the withers to the ground,
(8) back height (BH), height at the middle of the back, between the thoracic and the lumbar vertebrae,
(9) body length (BL), distance from the manubrium of the sternum to the pin,
(10) rump length (RL), distance from hip to pin,
(11) rump width (RW) maximum distance between left and right hurls,
(12) cannon perimeter (CP), perimeter of the right foreleg, between the knee and the pastern.

These variables were obtained using a ribbon measuring tape and a measuring stick for horses (Hauptner and Herberholz, Solingen, Germany). Additionally, live weight was recorded using fixed (SR2000, Tru-Test, Auckland, New Zealand) or portable FX1 (Iconix NZ, Oamaru, New Zealand) electronic scales.

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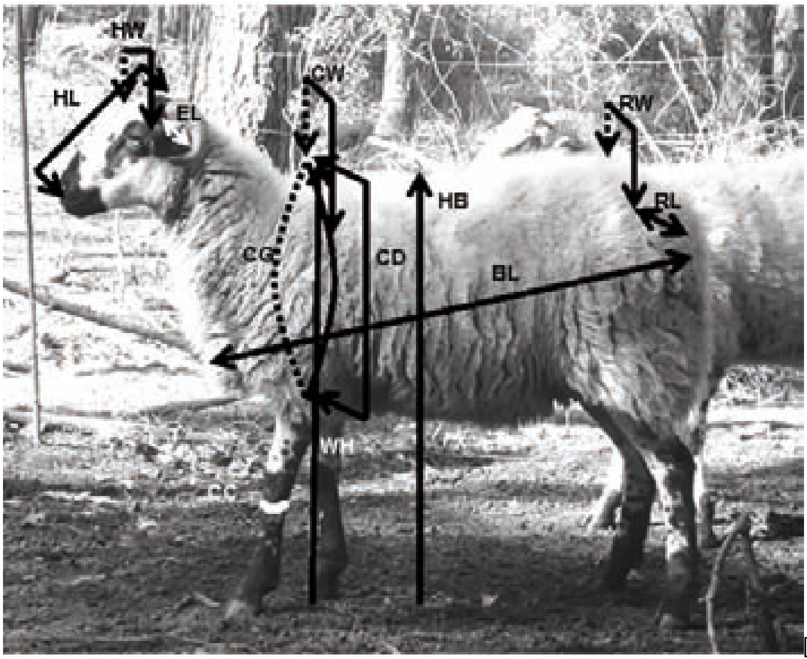
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Table 4.2 Definition of the zootechnical indexes calculated for each Ripollesa individual.

Indices	Type [†]	Calculation
Cephalic	Ethnological	HW / HL x 100
Thoracic	Ethnological	CW / CD x 100
Pelvic	Ethnological	RW / RL x 100
Corporal	Ethnological	BL / CG x 100
Dactyl-Thoracic	Functional	CC / CG x 100
Dactyl-Costal	Functional	CC / CW x 100
Relative Depth of Thorax	Functional	CD / WH x 100
Transversal-Pelvic	Functional	RW / WH x 100
Longitudinal-Pelvic	Functional	RL / WH x 100
Balance	Functional	(RW x RL) / (CD x CW)
Length	Functional	BL / WH
Cumulative	Functional	(W / □) + Balance Index + Length Index

HL: Head length; HW: Head width; EL: Ear length; CD: Chest depth; CW: Chest width; CG: Chest girth; WH: Withers height; HB: Height at the middle of the back; BL: Body length; RL: Rump length; RW: Rump width; CC: Cannon perimeter; W: Body weight; □: estimated average for W. [†] Ethnological indexes contributed general information about breed characteristics whereas functional indexes contributed information about the type, purpose and performance of the breed.

Statistical analyses

All measurements and indexes were separately analyzed under the following linear model,

$$Y_{ijk} = \quad + F_i + S_j + \quad _{ijk}$$

where Y_{ijk} was the dependent phenotypic record, was the population mean, F_i was the effect of the flock (1-8), S_j was the effect of the sex (1 or 2), and $_{ijk}$ was the residual term. Flock effects were contrasted by a one-way ANOVA test followed by the Student Newman-Keuls multiple comparison test, implemented in the General Linear Model procedure of SAS 9.1 (SAS Institute, Inc., Cary, NC, USA).

The residuals obtained from the previous analyses on morphological measurements were used for a principal component analysis (PCA) performed by the SPAD 5.5 (2002) software (Coheris, Suresnes, France). For all subsequent analysis, only data from ewes were used due to the small number of rams contributing to this study. This analysis allowed us to understand the differences among flocks with regard to morphological measures, where only principal components accounting for more than 10 percent of the phenotypic variance were retained.

On the basis of the estimates from the PCA analysis, a discriminant analysis (SPAD 5.5) was conducted to estimate the proportion of animals that were properly classified into their own flock. This was an additional way to evaluate within-flock resemblance and the degree of differences between flocks. As a final step, a cluster analysis (SPAD 5.5) was performed for classification of data to establish the optimum number of groups (i.e., subpopulations) based on the number of principal components accounting for at least 80 percent of the total inertia. Between-group differences of morphological measures were compared with a Student Newman-Keuls multiple comparison test (SAS 9.1).

Results and Discussion

Morphological diversity between sexes and flocks

According to the values reported in this study, the Ripollesa breed showed a marked sexual dimorphism, as rams (Figure 4.4) were larger than ewes (Figure 4.5) for almost all measurements ($P < 0.05$), except ear length and rump width (Table 4.3). Sexual dimorphism is a fundamental morphological characteristic of most ungulates (Andersson, 1994), and has important consequences for ecology, behaviour, population dynamics and evolution (LeBlanc et al., 2001).

Table 4.3 Mean, coefficient of variation (C.V.), minimum value (Min.) and maximum value (Max.) of the morphometrical measures.

Variables	Ewes				Rams
	Mean	C.V.	Min.	Max.	Mean
Head length, cm	23.7[a]	4.4	21	28	26.8[b]
Head width, cm	13.8[a]	4.5	11	17	15.4[b]
Ear length, cm	13.5[a]	7.7	10	16	13.2[a]
Chest depth, cm	30.7[a]	6.9	20	42	34.1[b]
Chest width, cm	18.8[a]	10.0	12	28	21.2[b]
Chest girth, cm	90.4[a]	5.1	75	108	100.9[b]
Withers height, cm	69.4[a]	4.4	58	80	75.9[b]
Height at the middle of the back, cm	68.2[a]	4.3	56	77	74.5[b]
Body length, cm	75.6[a]	5.3	43	85	84.1[b]
Rump length, cm	24.2[a]	6.9	15	29	26.5[b]
Rump width, cm	21.8[a]	6.5	16	29	22.5[b]
Cannon perimeter, cm	8.6[a]	6.1	7.5	10	10.0[b]
Weight, kg	51.4[a]	12.9	25	80	75.1[b]

Means with the same superscript did not differ significantly ($P > 0.05$) between sexes.

It is expected that all animal populations have certain variability between groups or subpopulations, these differences being of great importance to improve performance by selection. In our study, a moderate variability (CV ranging between 4 and 13 percent) in all the morphological measures considered was observed for the whole ewe sample (Table 4.3). The highest CVs were for live weight (12.9 percent), chest width (10.0percent), ear length (7.7 percent), chest depth (6.9 percent), rump length (6.9 percent) and rump width (6.5 percent). Despite this, the greatest differences between average estimates for each flock with respect to the overall means were reported for withers height (65.3 to 73.2 cm; 11.4 percent), chest depth (26.6 to 32.9 cm; 20.5 percent), rump width (19.8 to 22.9 cm; 14.2 percent), head width (12.5 to 14.7 cm; 15.9 percent) and ear length (12.5 to 14.5 cm; 14.8 percent). These differences could be

□ ei Z□s eHC□eB□el H□EHBEi □6I Z□□B□□ ZBS □□ C□v6 H□Z□TH HCZS E□□BS CZeZBS v□BT□H□ I □TB□Fn□
□BL □ZS HC□o Zel □L Bi 6I Bhveis □es i□ □CZTHi HS □Hv□el □ □L □ □ □ H□ EHS HeZ□Bi ZEZS d□

□

□□□□□□□□□□ □BT□el H□Z6 BHv□ vI HH6□i HHCd□

□

□ H□BL 6□i HC□el H□Z6 BHv□ □i HHC□o Zel □i HHCv□B□ HC□ZS □S HZEI □Bs i□EHBEi□ I Z□□
□ Hv□ □ZS □Bi CHi □eB□I □ □ eHi Zf H□el Z□i HHC□ C□I ZEI EI e□CZTHi HS □Hv□ C□vZL Z□ ZeZHv□o Zel □
i H□eHC□i HHCvg□Z6 BHv□ Ho Hv□I □ □Ei He□ Hi □L Bi 6I BBEZ□ □L Hv□ s i Hvn□L □ S k□i HE□ CZS E□
I H□ □o ZCel n□i s L 6□HS Eel n□i s L 6□o ZCel □ C□BCk□HS Eel n□el □ □el BvH□i H6 Bi eHC□TBi □el H□
□S□ Z□ , □t □i Hf □He□ □1GGG□ n□ □HE□ , □S□I Hf □He□ □1GGG□ □L Hi □ , □t □ Hf □He□ □
1GGG□ □Z7s He□ , □t H□ Hen□1GG) □ Fv□ □ C□ □ , □ □ Bn□1GG) □vI HH6□i HHCvd□

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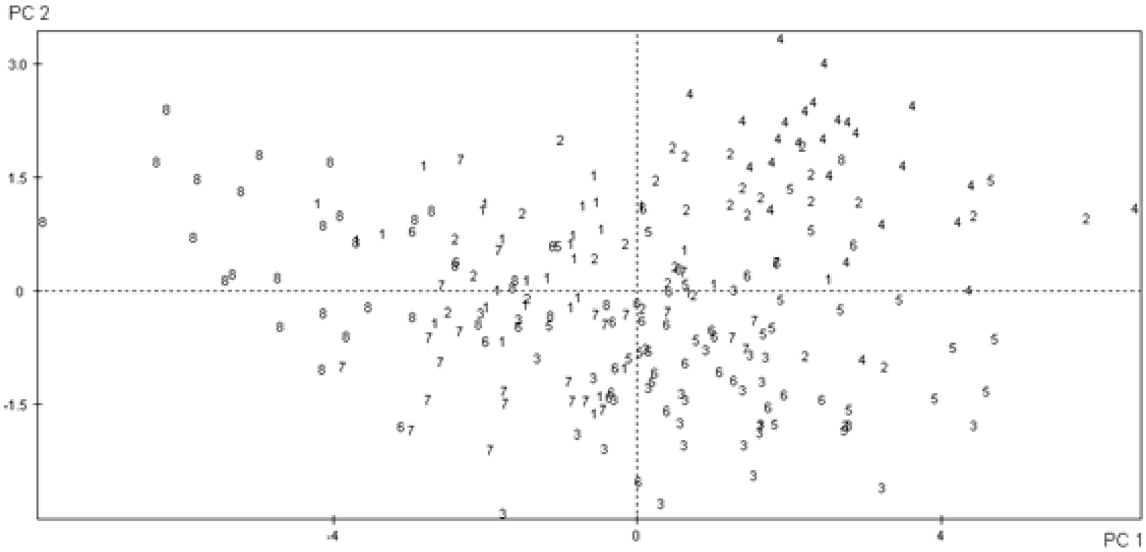
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-1.5
-4
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PC 1

Table 4.4 Average of the morphological measures and live weight of Ripollesa ewes of flocks of different origins.

	CU	UA	PM	JM	OS	CS	MR	DG	RMSE[†]
Number of animals	30	29	29	27	24	30	27	28	
Head length, cm	22.8^{a}	23.2^{a}	24.9^{b}	24.1^{c}	25^{b}	24^{c}	23.3^{a}	22.2^{d}	1.1
Head width, cm	13.7^{ab}	13.7^{ab}	14.1^{ac}	14.7^{d}	13.6^{b}	14.3^{c}	13.7^{ab}	12.5^{e}	0.6
Ear length, cm	12.9^{ab}	13.8^{cd}	14.5^{e}	12.5^{a}	13.4^{bc}	14.1^{cde}	14.2^{ce}	13^{ab}	1.1
Chest depth, cm	29.8^{ab}	32^{c}	32.4^{c}	32.9^{c}	32.2^{c}	30.8^{b}	28.8^{a}	26.6^{d}	2.0
Chest width, cm	16.8^{a}	20.7^{b}	18.24^{cd}	22.4^{e}	19.4^{d}	18.8^{d}	16.9^{a}	17.3^{cd}	1.9
Chest girth, cm	89.1^{a}	95.4^{b}	89.2^{a}	100.1^{c}	90.5^{a}	89^{a}	87.6^{a}	82.7^{d}	4.6
Withers height, cm	68.2^{a}	68.9^{ab}	70.8^{bc}	71.2^{c}	73.2^{d}	69^{ab}	69.1^{ab}	65.3^{e}	3.1
Height at the middle of the back, cm	67.4^{a}	67.7^{ab}	69.1^{ab}	69.7^{c}	72.1^{a}	67.9^{ab}	68.1^{ab}	64.3^{d}	2.9
Body length, cm	73.4^{a}	74.7^{ab}	78.8^{c}	78.3^{c}	77.0^{cb}	77.1^{cb}	74.9^{ab}	71.1^{d}	4.1
Rump length, cm	23.2^{a}	25.6^{ab}	25.6^{ab}	24.5^{b}	25.9^{b}	24.9^{ab}	24.1^{ab}	19.9^{c}	3.5
Rump width, cm	22.1^{ab}	22.9^{b}	20.5^{cd}	24^{e}	22.5^{b}	21.4^{a}	21.3^{ad}	19.8^{c}	1.4
Cannon perimeter, cm	8.4^{a}	8.5^{a}	8.4^{a}	9.2^{b}	9^{bc}	8.4^{a}	8.8^{ac}	8.4^{a}	0.5
Weight, kg	49.1^{a}	58.3^{b}	51.2^{a}	61.5^{b}	59.4^{b}	51^{a}	44.2^{c}	37.9^{d}	6.6

Flock of origin = CU, Cal Terrisco; UA, SGCE of the Universitat Autònoma de Barcelona; PM, Las Parras de Martín; JM, Mas Muxach; OS, Montseny; CS, Cal Sabaté; MR, Mas Ros; DG: SEMEGA, Diputació de Girona. [†]RMSE: Root Mean Square Error. Means with the same superscript did not differ significantly ($P > 0.05$).

Table 4.5 Eigenvectors from the principal components analysis performed on the morphological measurements.

	PC 1[†]	PC 2
Head length, cm	0.26	0.09
Head width, cm	0.22	0.25
Ear length, cm	0.15	0.22
Chest depth, cm	0.25	-0.03
Chest width, cm	0.24	-0.42
Chest girth, cm	0.40	-0.40
Withers height, cm	0.33	0.44
Height at the middle of the back, cm	0.33	0.46
Body length, cm	0.28	-0.06
Rump length, cm	0.27	-0.03
Rump width, cm	0.26	0.05
Cannon perimeter, cm	0.27	-0.11
Live weight, kg	0.36	-0.35

[†] PC: Principal component; PC1 accounted for 47.6 percent of the variance and PC2 accounted for 12.3 percent of the variance.

Discriminant and cluster analyses

The results from the discriminant analysis (Table 4.6) confirmed this partial overlapping as the percentage of individuals correctly classified into their own flock ranged between 70 and 100 percent, with only 18.7 percent of the animals, on average, being classified in wrong flocks. The high percentages of matching suggested a marked degree of differentiation among flocks, being the greatest in the SEMEGA (#7) flock in which 100 percent of their own ewes were assigned correctly and only 2 ewes more from other flocks were incorrectly assigned to this flock.

Table 4.6 Number of animals and corresponding percentage classified into each flock from the discriminant analysis.

	CU[†]	UA	PM	JM	OS	CS	MR	DG	Total
CU	25 (83.3)[‡]	2 (6.7)	0	1 (3.3)	0	1 (3.3)	0	1 (3.3)	30
UA	2 (6.9)	21 (72.4)	1 (3.5)	4 (13.8)	0	1 (3.5)	0	0	29
PM	0	0	25 (86.2)	0	0	4 (13.8)	0	0	29
JM	1 (3.7)	2 (7.4)	0	23 (85.2)	0	1 (3.7)	0	0	27
OS	0	0	2 (8.3)	2 (8.3)	19 (79.2)	1 (4.2)	0	0	24
CS	1 (3.3)	3 (10)	3 (10.0)	0	1 (3.3)	21 (70)	1 (3.3)	0	30
MR	3 (11.1)	1 (3.7)	0	0	0	1 (3.7)	20 (74.1)	2 (7.41)	27
GD	0	0	0	0	0	0	0	28 (100)	28
Total	32	29	31	30	20	30	21	31	224

Flock of origin = CU, Cal Terrisco; UA, SGCE of the Universitat Autònoma de Barcelona; PM, Las Parras de Martín; JM, Mas Muxach; OS, Montseny; CS, Cal Sabaté; MR, Mas Ros; DG: SEMEGA, Diputació de Girona. [†] Rows indicate the flock-of-origin of the animals whereas columns indicate the flock where each animal is assigned. [‡] Number of animals correctly classified and corresponding percentage (rounded off in parentheses to the nearest unit).

On the other hand, the cluster analysis defined four sheep groups, each represented mainly by the following flocks (number of ewes and percentage of matching):

(1) Group 1 (19.6 percent of the ewes): Mas Muxach (24 ewes, 89 percent) and SGCE (13 ewes, 45 percent), characterized by being heavy and large framed animals.
(2) Group 2 (17.9 percent of the ewes): Montseny (13 ewes, 54 percent) and Las Parras de Martín (13 ewes, 45 percent), characterized mainly by being tall animals.
(3) Group 3 (40.6 percent): Cal Sabaté (20 ewes, 67 percent), Cal Terrisco (20 ewes, 67 percent) and Mas Ros (14 ewes, 52 percent), characterized by including animals with intermediate frame and long ears.
(4) Group 4 (21.9 percent): SEMEGA (24 animals, 86 percent), with the smallest body size (Table 4.7).

This grouping can be justified in part by the different subpopulations that contributed to the studied flocks. Although the Montseny and Las Parras de Martín flocks must have come from the same original subpopulations as do Mas Muxach and SGCE (Hilarenca and Igualadina subpopulations), they are characterized by having a greater height than the general average. Even assuming a common origin, departures between Group 1 and Group 2 must be probably linked to variable contributions from the Hilarenca and Igualadina historical subpopulations and an independent evolution during several years or decades. Focusing on Group 3, it was expected that animals from Cal Sabaté flock had a medium size, since this flock derived from original Hilarenca and Queralpina subpopulations, although differing from flocks assigned to Groups 1 and 2; in a similar way, the Cal Terrisco flock (Lluçanenca subpopulation) and Mas Ros flock (Queralpina subpopulation) were assigned to this Group 3. Nevertheless, there are also animals from the original Queralpina subpopulation in the group of SEMEGA ewes, the smaller individuals of the Ripollesa breed reported.

Within this context, the morphological characteristics of the historical subpopulations are still present in current morphological groups, although influences from more than one subpopulation could be found in the same flock and independent evolutionary patterns would have led to different subpopulations although departing from the same original genetic background. This makes evident the moderate to low genetic flow between flocks, where some specific morphotypes were preferentially preserved in each flock. In consequence, a substantial genetic structure could be anticipated in the Ripollesa populations, increasing the complexity of a conservation program.

Table 4.7 Means of the variables studied in females of each group of Ripollesa sheep breed.

	Group 1	Group 2	Group 3	Group 4
Number of animals	56	53	87	28
Head length, cm	23.6^{a}	24.9^{b}	23.3^{a}	22.2^{c}
Head width, cm	14.2^{a}	13.9^{a}	13.9^{a}	12.5^{b}
Ear length, cm	13.2^{a}	14.0^{b}	13.7^{b}	13.0^{a}
Chest depth, cm	32.4^{a}	32.3^{a}	29.8^{b}	26.6^{c}
Chest width, cm	21.5^{a}	18.8^{b}	17.5^{c}	17.3^{c}
Chest girth, cm	97.7^{a}	89.8^{b}	88.6^{b}	82.7^{c}
Withers height, cm	70.0^{a}	71.9^{b}	68.8^{a}	65.3^{c}
Height at the middle of the back, cm	68.7^{a}	70.5^{b}	67.8^{a}	64.3^{c}
Body length, cm	76.5^{ab}	78.0^{a}	75.1^{b}	71.1^{c}
Rump length, cm	25.1^{a}	25.7^{a}	24.1^{b}	19.9^{c}
Rump width, cm	23.4^{a}	21.4^{b}	21.6^{b}	19.8^{c}
Cannon perimeter, cm	8.8^{a}	8.7^{ab}	8.5^{bc}	8.4^{c}
Weight, kg	59.9^{a}	54.9^{b}	48.2^{c}	37.9^{d}

Means with the same superscript did not differ significantly ($P > 0.05$). Group 1: Mas Muxach and SGCE flocks; Group 2: Montseny and Las Parras de Martín flocks; Group 3: Cal Sabaté, Cal Terrisco and Mas Ros flocks; Group 4: SEMEGA flock.

Differences among flocks were also found by Avellanet (2006) in ewes of the Xisqueta breed, where the values of the morphological measures varied depending upon the location of the flocks, management, and feeding, among others. Also Kunene et al. (2007) found that the location of the flocks had a significant effect on the morphological measures of Zulu ewes. In this study, however, it is possible that the differences among flocks could also have a genetic origin because some of the differences among the hypothetical subpopulations of origin are retained when the flocks are reared in other areas.

Zootechnical indexes

The calculation and analysis of the different zootechnical indexes allowed us to ethnologically classify the Ripollesa sheep breed (Table 4.8). On the basis of the cephalic index, the Ripollesa showed to be a dolichocephalic breed, since the length of the head predominated over the width. Both the thoracic and the length indexes allowed us to classify the breed as long-shaped, whereas the pelvic index indicated that it is a convex breed, with the rump length predominating in relation to its amplitude. The breed had a medium frame according to the dactyl-thoracic and dactyl-costal indexes. These results agreed with the visual valuations of Torre (1991) and Guillaumet and Caja (2001). The relative depth of the thoracic index indicated that the breed is suitable for meat production, lower values indicating better meat aptitude (Aparicio, 1944), in agreement with Daza (1997), Guillaumet and Caja (2001) and Milan et al. (2003). This index also indicated the length of the legs suggests that the breed had good adaptation to the environmental conditions under which it is raised. The transversal pelvic and longitudinal pelvic indexes also provided information about the aptitude of the animal, supporting the Ripollesa as a sheep breed for meat production, which reinforces the results obtained from the calculation of the cumulative index.

Given that some of the indexes gave the same information, we suggest simplifying the number of analyzed indexes for the future to the following ones: thoracic, cephalic, pelvic, dactyl-thoracic, and relative depth of thorax. These subsets of indexes are enough to ethnologically classify the breed and also to provide information about the productive purposes of the Ripollesa breed.

Average differences between flocks and subpopulations of Ripollesa relied on sheep size, weight and height. The cluster analysis suggested four differentiated groups, although there were ewes that could not be assigned to a particular group. The results of the analyzed indexes allowed us to classify the Ripollesa sheep breed as medium-framed and convex, predominantly suitable for meat production.

Table 4.8 Mean, standard deviation (S.D.), coefficient of variation (C.V.), standard error (S.E.), minimum value (Min.) and maximum value (Max.) of the calculated zootechnical indexes.

Indices	Mean	S.D.	C.V.	S.E.	Min.	Max.
Cephalic	58.4	3.7	6.3	0.2	48.0	76.2
Thoracic	61.5	8.1	13.2	0.5	41.4	87.1
Pelvic	90.8	9.8	10.8	0.5	73.1	129.4
Corporal	83.9	6.1	7.3	0.3	47.8	101.2
Dactyl-Thoracic	9.6	0.7	7.3	0.0	7.8	11.7
Dactyl-Costal	46.6	6.1	13.0	0.3	30.8	69.2
Relative depth of Thorax	44.2	3.7	8.3	0.2	29.4	60.3
Transversal-Pelvic	31.4	2.5	8.0	0.1	26.4	38.7
Longitudinal-Pelvic	34.9	3.1	8.9	0.2	23.8	43.3
Balance	0.9	0.1	15.6	0.0	0.5	1.4
Length	1.1	0.1	5.8	0.0	0.6	1.3
Cumulative	3.0	0.2	7.2	0.0	2.0	3.6

Note that our results contribute essential information to characterize this meat-type breed following FAO recommendations, and has become a relevant source of basic information to support the conservation and selection program of the Ripollesa sheep breed.

Capítulo 5

BAYESIAN INFERENCE OF MATERNITIES

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$$\mathbf{y} = \mathbf{Xb} + \mathbf{Wp} + \mathbf{Za} + \mathbf{e}$$

[illegible] $_i = \{\neq_1, \neq_2, \ldots, \neq_n\}$ [illegible] $\mathbf{y}_i$ [illegible] $\mathbf{y}_i$ [illegible]

$$p\left(\mathbf{y}_i \middle| \; _i = \neq_j, \mathbf{b}, \mathbf{p}, \mathbf{a}, \; ^2_e\right) \quad \exp \quad \frac{1}{2}\left(\mathbf{y}_i \quad \mathbf{x}_{i(j)}\mathbf{b} \quad \mathbf{w}_{i(j)}\mathbf{p}_{i(j)} \quad \mathbf{a}_{i(j)}\right) \; _e^2\left(\mathbf{y}_i \quad \mathbf{x}_{i(j)}\mathbf{b} \quad \mathbf{w}_{i(j)}\mathbf{p}_{i(j)} \quad \mathbf{a}_{i(j)}\right)$$

$$p\left(\mathbf{y}\middle|\ ,\mathbf{b},\mathbf{p},\mathbf{a},\ {}^{2}_{e}\right)=\prod_{i=1}^{m} p\left(\mathbf{y}_i\middle|\ {}_i = \neq_j,\mathbf{b},\mathbf{p},\mathbf{a},\ {}^{2}_{e}\right)$$

$$p\left(\mathbf{p}\middle|\ {}^{2}_{p}\right)\sim N\left(\mathbf{0},\mathbf{I}_p\ {}^{2}_{p}\right)$$

$$p\left(\gamma_i = j \mid \mathbf{y}_i, \mathbf{b}, \mathbf{p}, \mathbf{a}, \sigma_e^2\right) = \frac{\exp\left(-\frac{1}{2}\left(\mathbf{y}_i - \mathbf{x}_{i(j)}\mathbf{b} - \mathbf{w}_{i(j)}\mathbf{p}_{i(j)} - \mathbf{a}_{i(j)}\right)' \sigma_e^{-2}\left(\mathbf{y}_i - \mathbf{x}_{i(j)}\mathbf{b} - \mathbf{w}_{i(j)}\mathbf{p}_{i(j)} - \mathbf{a}_{i(j)}\right)\right)}{\sum_{k=1}^{n} \exp\left(-\frac{1}{2}\left(\mathbf{y}_i - \mathbf{x}_{i(k)}\mathbf{b} - \mathbf{w}_{i(k)}\mathbf{p}_{i(k)} - \mathbf{a}_{i(k)}\right)' \sigma_e^{-2}\left(\mathbf{y}_i - \mathbf{x}_{i(k)}\mathbf{b} - \mathbf{w}_{i(k)}\mathbf{p}_{i(k)} - \mathbf{a}_{i(k)}\right)\right)}$$

$$\mathbf{y}_S = N(\mathbf{X}_S\mathbf{b}_S + \mathbf{Z}_{S1}\mathbf{p}_S + \mathbf{Z}_{S2}\mathbf{a}_S, \mathbf{I}_{S,e}\ {}^{2}_{S,e})$$

$\mathbf{b}_S$ … $\mathbf{p}_S$ … $\mathbf{a}_S$ … $\mathbf{X}_S$ … $\mathbf{Z}_{S1}$ … $\mathbf{Z}_{S2}$ … $\mathbf{I}_{S,e}$

$\sigma^2_{S,e}$

$\mathbf{b}_S$

$\mathbf{b}_S$

$\mathbf{Z}_{S2}\mathbf{a}_S$

$\mathbf{p}_S = N\left(\mathbf{0}, \mathbf{I}_{S,p}\sigma^2_{S,p}\right)$ $\mathbf{I}_{S,p}$

$\sigma^2_{S,p}$

$N\left(0, \sigma^2_{S,a}\right)$ $\sigma^2_{S,a}$

$N\left(0, \frac{1}{2}(1-f)\sigma^2_{S,a}\right)$

σ^2_a $_i$

$\mathrm{PARD}_i = \mathrm{I}_{rd}/\mathrm{I}_T$ I_{rd}

I_T

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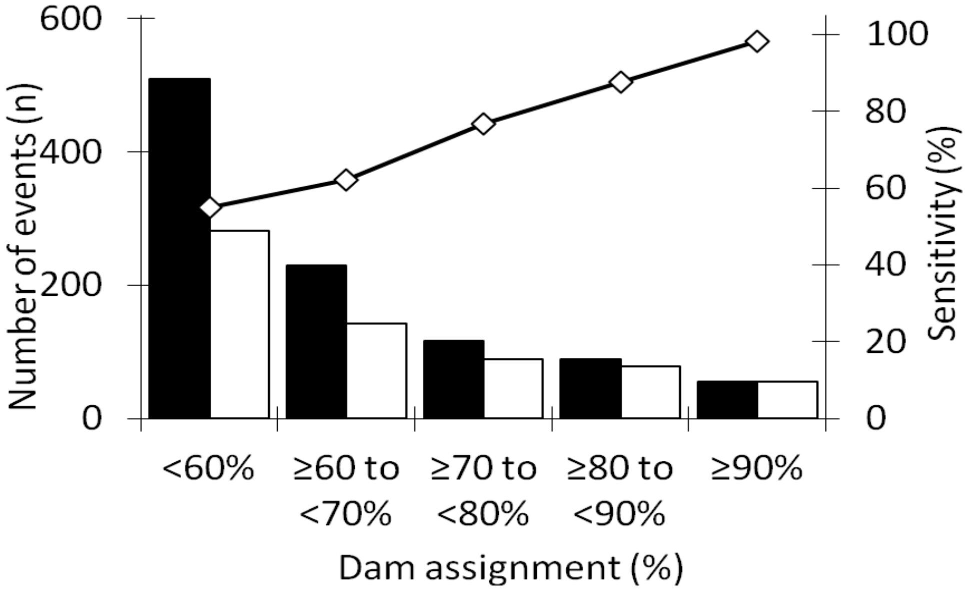
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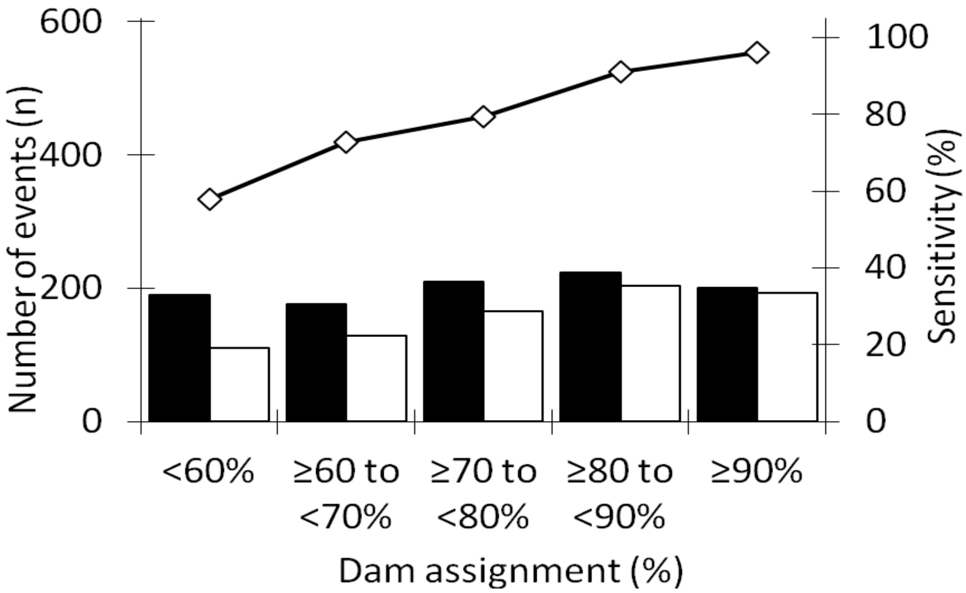
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Dam assignment (%)

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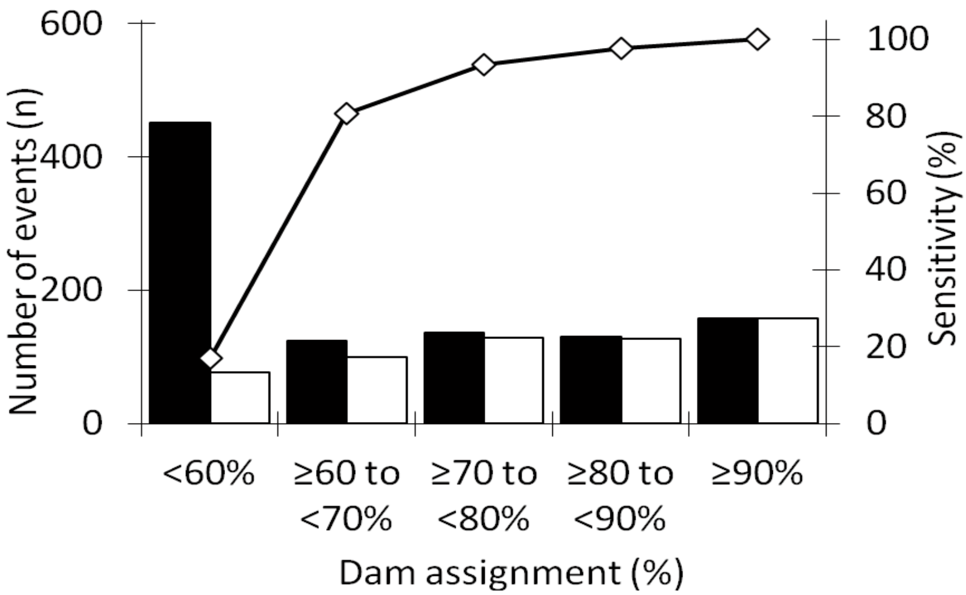

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Sensitivity (%)
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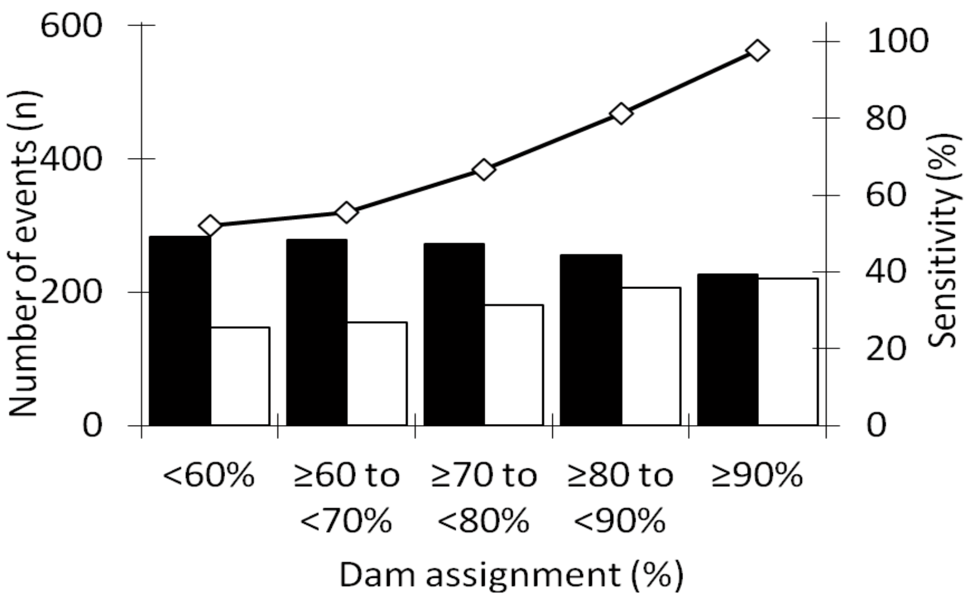
Dam assignment (%)



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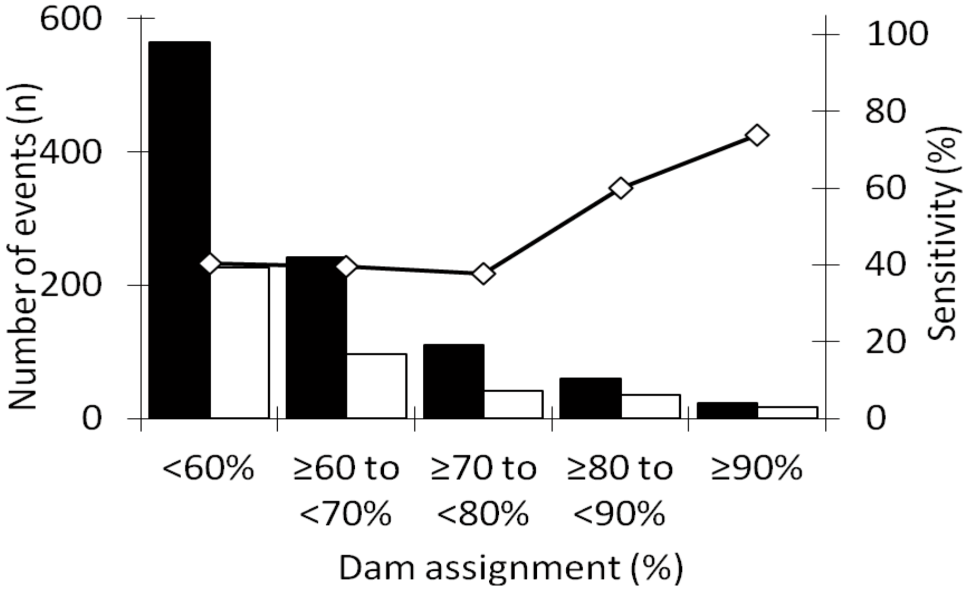
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Dam assignment (%)

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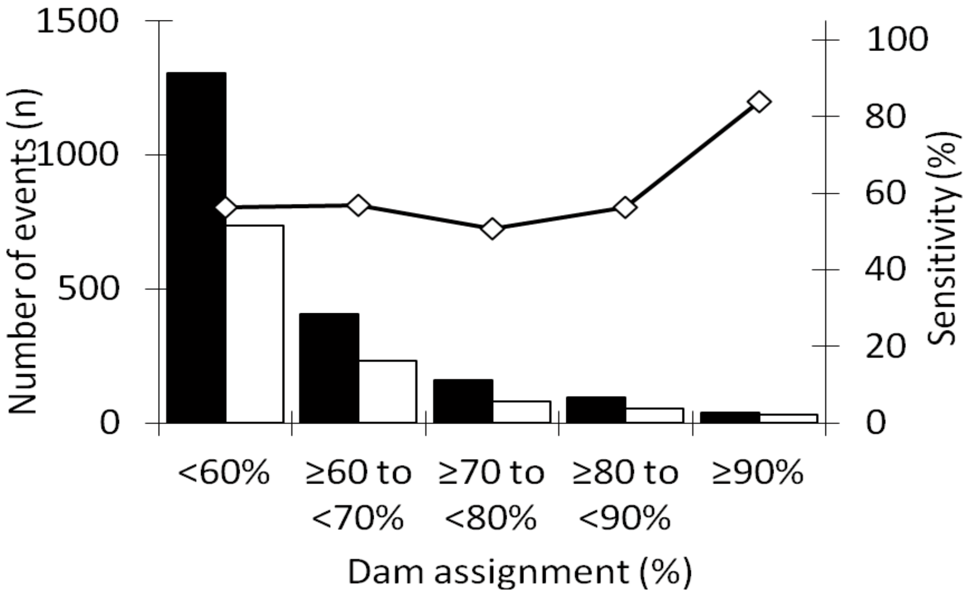
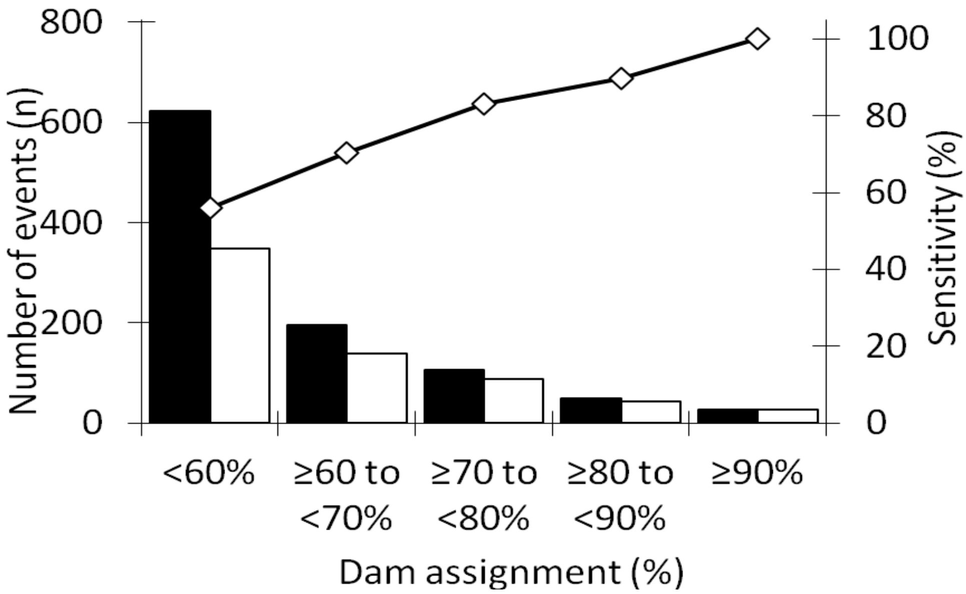
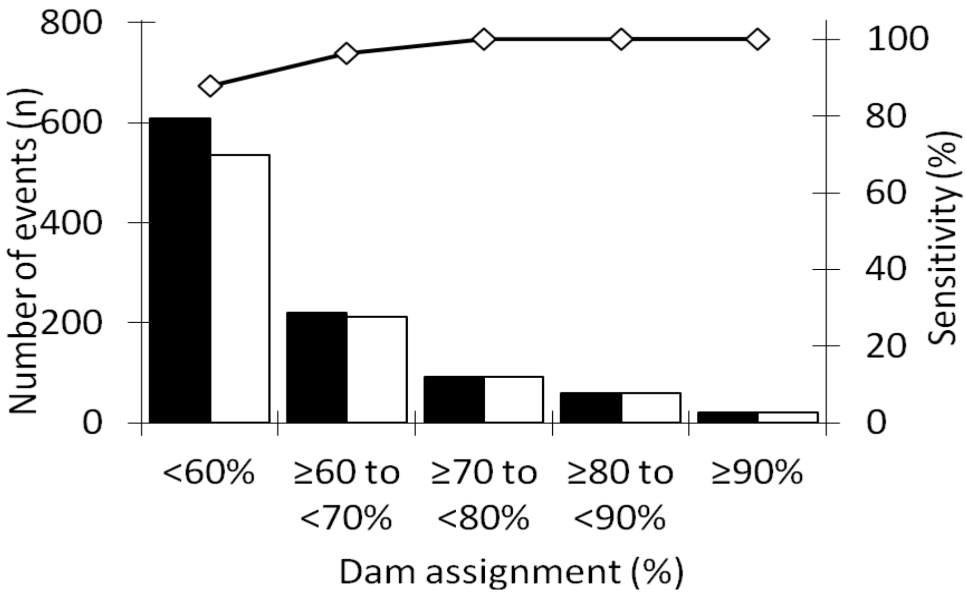
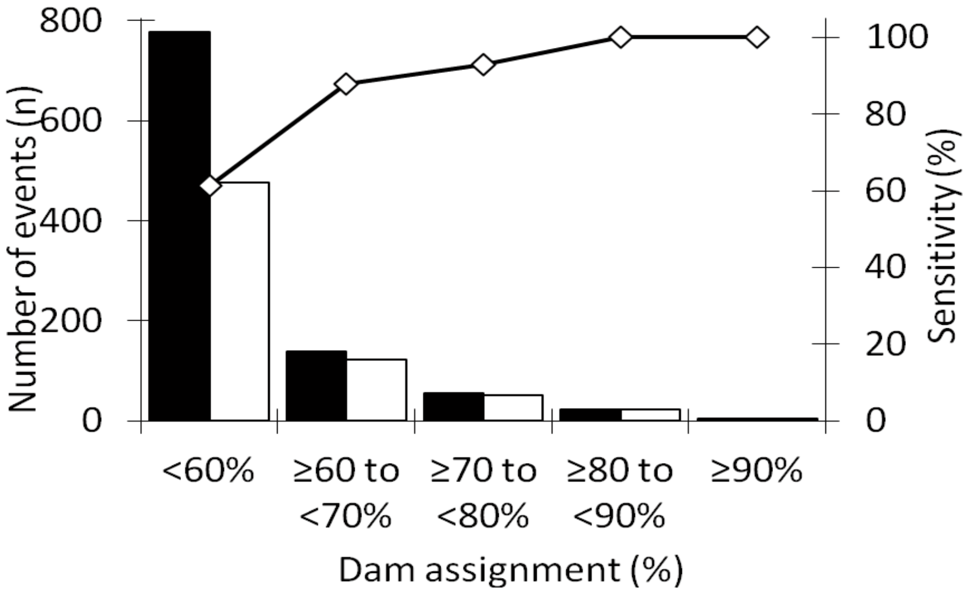

1500
1000
500
0
Number of events (n)
100
80
60
40
20
0
Sensitivity (%)
<60%
≥60 to <70%
≥70 to <80%
≥80 to <90%
≥90%
Dam assignment (%)


800
600
400
200
0
Number of events (n)
100
80
60
40
20
0
Sensitivity (%)
<60%
≥60 to <70%
≥70 to <80%
≥80 to <90%
≥90%
Dam assignment (%)


800
600
400
200
0
Number of events (n)
100
80
60
40
20
0
Sensitivity (%)
<60%
≥60 to <70%
≥70 to <80%
≥80 to <90%
≥90%
Dam assignment (%)


800
600
400
200
0
Number of events (n)
100
80
60
40
20
0
Sensitivity (%)
<60%
≥60 to <70%
≥70 to <80%
≥80 to <90%
≥90%
Dam assignment (%)

[illegible]

[illegible]

Capítulo 6

REAL-TIME ULTRASOUNDS IN LIGHT LAMBS

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

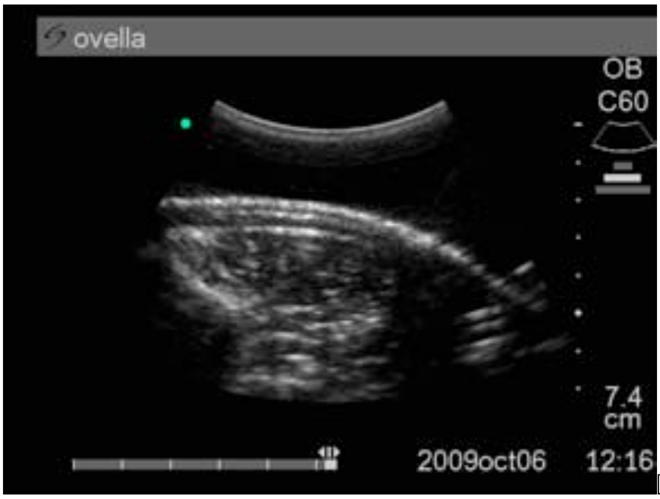
[illegible]

[illegible]

[illegible]

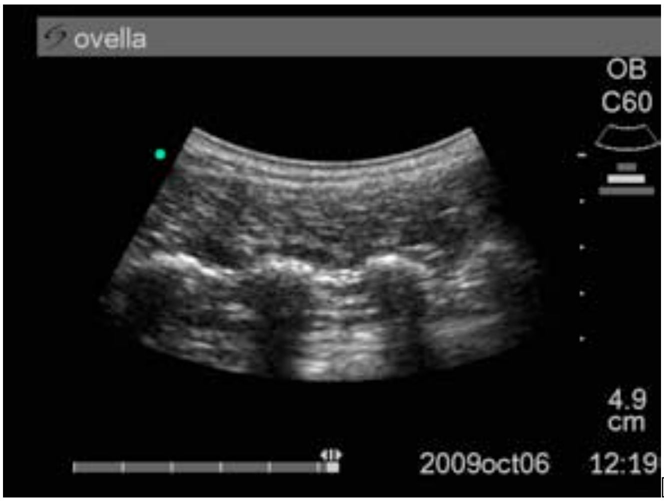
[illegible]

[illegible]


ovella
OB
C60
7.4
cm
2009oct06
12:16

[illegible]

[illegible]


ovella
OB
C60
4.9
cm
2009oct06
12:19

[illegible]

[illegible]

$$MSPE = \frac{\sum_{i=1}^{n} (CS_i \quad US_i)^2}{n}$$

$$ECT = (\quad_{CS} \quad \quad_{US})^2$$

$$ER = \left[SD_{CS} \quad (r \quad SD_{US})\right]^2$$

$$ED = (1 \quad r^2) \quad SD_{US}^2$$

[illegible]

[illegible]

$$SEP = \sqrt{\frac{\sum_{i=1}^{n} \left(CS_i - US_i - \left(\overline{CS} - \overline{US}\right)\right)^2}{n-1}}$$

[illegible]

[illegible]

[illegible]

[illegible]

ei1□sl□ 1es c)□□ 1c□□edm□□□□d□□1e□ □□1 1s s□cc□e□□ □□□□ □□ □i□1s□ □c□□b □c2□ □□□1yem□ □l□□)□kñqq8B□ □□ □□□ 1c□ds □□i□cl 1b □ 1es □e□ □□yi□ccdi□□e□□ □□yie□□)□□ □□□b □ a□ □□ ds□□i□cl 1b □l 1es □e□□□□□cd□□□cl□□□□ □b 1□□□y ym□□ 1mg□e□□i□mW1b □□dmi□ eds□c□1s□ y□c□dm□W1gy□□m□ l□b □c□ei□um□dl□ 1es □e□□□ s□cc□□□i□□2□ 1c□□1s□□□ □□ 1□□i1□i1es□□ei□ pdm1g□ □□yi1□□1s□□ □□1□iis □□ □□edsli1□c□k□ d□e□□l□m)2□ñqqqB)□

□□□□□B O□□ □□ 2□cl□ □□ □□□□u□ 1es□k□□B□□b □ 1b db□□ □□b 1s 1b db□e□□li□ cu□icm□ dmi□ eds□□b □□ di□b□slc□□ □□el □l ei□ 1□□ □□db □□ □□u□□ks□á□Sñ40□□ □i□ □□□□ □á□ ñ-)98□6□S)ñ4□a□B)□

□i□1[S]	□ □□ □	□□□	□ 1s 1b db □	□ □ 1b db □
□ ei□ 1□□u□□				
□□□□2□b b □	S)-S□	q)ñ8□	q)8S□	ñ)4-□
□□□2□b b	S)-4	q)44	q)99	P)8ñ
□□□ □□ 2□b □	ñ)4q□	q)ñR□	S)98□	P)q4□
□□□ □□ 2□b □□	4)RP□	q)Rñ□	ñ)4P□	-)9q□
□□□ 2□b [ñ]	8)H8	S)ñR	-)49	Sñ)9q
□db □□i□u□□				
□□□□2□b b □	S)R9□	q)ñ9□	S)qH□	ñ)ñ-□
□□□□□2□b b □	S)HP□	q)-q□	q)H9□	R)4R□
□□□ □□ 2□b □	ñ)P8□	q)ñ-□	S)9-□	P)ñP□
□□□ □□ 2□b □□	4)R9□	q)RP□	P)ñR□	-)Pñ□
□□□ □□ 2□b [ñ]	8)94□	S)Pñ□	-)H-□	SP)-R□

[S] □a1s□l 1□as□cc□k□□B□□cd□□dl□s□edc□□□aw□□l□ 1□as□cc□k□□B□□□yl □k□□B□□h 1□l □k□ □□B□□s□□□i□□k□□B□e□□ □□□□□□ □□□□□□□u□m□dl□□□□ln□□s□Sñl □□s□□SPl □l ei□□1□u□il□□i□□□kl ei□□1□□u□m□ei□□ln□□s□Scl□□s□□ ñs□□db □□i□u□il□□i□□□k□db □□i□□u□m□B)□

????? B N?? ?s ?cls ?? ????u1 1es ?k?? B?b v 1b db ?s ??b 1s 1b db ?e? rr es ?1d?1s m? dmi? eds ?1b ?c di?b ?s lc1 ??el 1 ei? 1?s ?db ?? ?u?rnds áSñ40? ?i? ??? áñ-)98? 6?S)ñ4a?B)?

??i?1 [S]	? ?s ?	???	? 1s 1b db ?	? v 1b db ?
? ei? 1??u?r??	?	?	?	?
?????2b b ?	S)S9?	q)ñq?	q)-4?	S)--?
?????2b b ?	S)ñ4?	q)PS?	q)Hñ?	P)Pq?
???? ??2??b ?	ñ)ñS?	q)ñR?	S)-R?	ñ)89?
?db ??i??u?r??	?	?	?	?
?????2b b ?	S)ñP?	q)ñS?	q)-4?	S)H9?
?????2b b ?	S)ñ9?	q)P8?	q)-4?	P)-H?
???? ??2??b ?	ñ)SR?	q)ñ9?	S)4ñ?	P)ññ?

[S] ?a1s ?1 1?as ?cc?k?? B?cd??dl ?s ?edc????aw??l ?1 1?as ?cc?k??? B?s ????yl ?k?? B?e????????? ???????u?rd?l ??? ??ln ??s ?Sñl ??s ??SPl ?l ei??1??u?il??i???kl ei??1??u?r B?ei???ln ??s ?Scl ??s ??ñs ??db ??i?u?il??i??? kdb ??i???u?rB)

????? B D?? ?s ?cl ?s ?? ????u1 1es ?k?? B?b v 1b db ?s ??b 1s 1b db ?e??l is cu?ic m???? ??cc? b ?c di?b ?s lc1 ??el 1 ei??1?s ?db ?? ??u?rnds áSñ40? ?i? ??? áñ-)98?6?S)ñ4a?B)?

?i?1 [S]	? ?s ?	???	? 1s 1b db ?	? v 1b db ?
? ei? 1??u?r??	?	?	?	?
?????2b b ?	ñ)Pq?	q)-9?	q)9P?	-)qq?
???? ??2??b ?	ñ)4H?	q)ñH?	S)Hq?	P)Sq?
???? ??2??b ??	4)Rq?	q)P8?	ñ)-q?	R)4q?
???? ??2??b [ñ]	8)8H?	S)ñ9?	-)8-?	SP)-q?
?db ??i??u?r??	?	?	?	?
?????2b b ?	ñ)4-?	q)9S?	S)qq?	-)-H?
???? ??2??b ?	ñ)49?	q)ñ8?	S)8q?	P)Pq?
???? ??2??b ??	4)-q?	q)4ñ?	P)-q?	R)-q?
???? ??2??b [ñ]	Sq)S8?	S)P8?	H)4S?	SP)-8?

[S] ?a1s ?1 1?as ?cc?k?? B?cd??dl ?s ?edc????aw??l ?1 1?as ?cc?k??? B????yl ?k?? B?n 1?l ?k?? B?s ???i???k?? B?e?? ????????? ???????u?rd?l ????ln ??s ?Sñl ??s ??SPl ?1 ei??1??u?il??i???kl ei??1??u?r B?ei???ln ??s ?Scl ??s ?? ñs ??db ??i?u?il??i???kdb ??i???u?rB)?

?

[illegible]

[illegible] ces yie d lwb eb sl eii m 1es e 1 slc ln s mwl1b dmic eds 1 l c cb cdi b slc c en s 1s m-)4) 1 l es mg v yl 1es e 2mm li 1 lc yieu1 1 8 c1 s 1 8 l k z q)qRB eii m 1es c n 1 cl 1b l c 8 1s ln s q)- SS k 2mdb mu mB q)994 k 2 l ei 1 mu m) el 1 l eii m 1es c n i c1b 1m k 7 q)qRB ei el s me 1es c k m-)4B s 1 i ei lis cu icm dmic eds u1 n c l 8 ei mes 1d 1s m u1 n c0 1 i s c b es dmic eds u1 n c n i c1 s 1 s l k z q)qRB 2n 1 1 es mg v yl 1es e 1 1 ei 1 mu m k z q)SB) c cdmcd cl 1 mes 1d 1s m u1 n c edm e m b 1 sl i cl 1s m l b c2n i c el 1 ei 1 8 mdb 8 eb 1 me 1es c b dcl u1 n c mnl is l 1u eyl 1es c n 1 c1b 1m y i eib 8 c)

[illegible] B G eii m 1es e 1 sl ln s 1 l c c8 dmic eds b c di b slc 1s m l mb c)

	[illegible] mic eds u1 n	
	i s cu i cm[S]	es 1d 1s m[ñ]
aw l 1 1as cc		
ei 1 mu m[P]	q)RRqVVVV	q)Rq- VVVV
db i mu m[4]	q)- qñVVVV	q)PS9VVV
yl e l b dc m		
ei 1 mu m	q)994VVVV	q)- 8PVVVV
db i mu m	q)9RHVVVV	q)- SSVVVV
1 l e l b dc m		
ei 1 mu m	q)HqqVVVV	
db i mu m	q)- 8PVVVV	
i e l b dc m		
ei 1 mu m	q)HS8VVVV	
db i mu m	q)HH- VVVV	

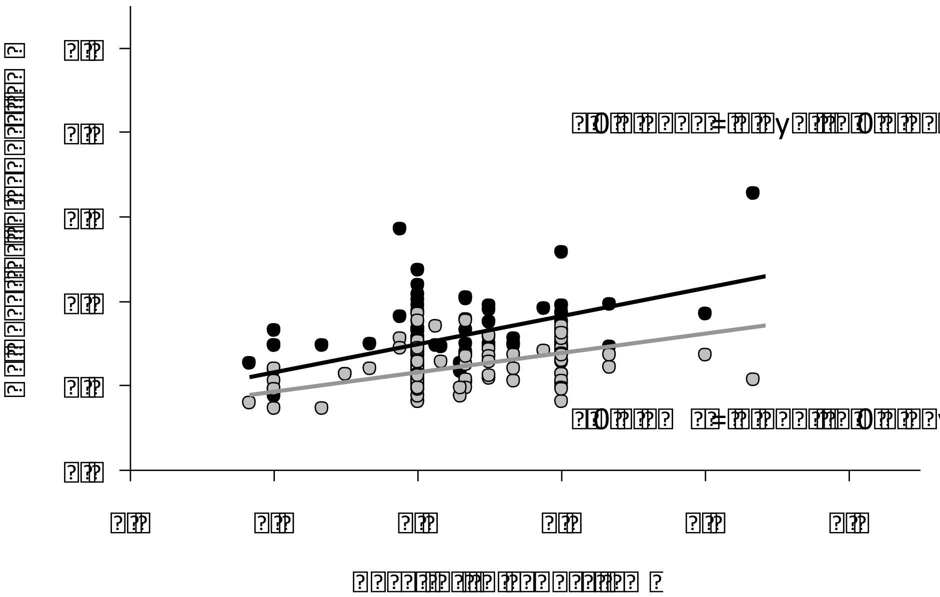
[S] iy s 1dm i e 1 mes 1d 1s m v1 e mb). [ñ] i m e 1 mes 1d 1s m v1 e mb). [P] ln s Sñl s SPl 1 ei 1u il i). [4] ln s Scl s ñs mdb i u il i).

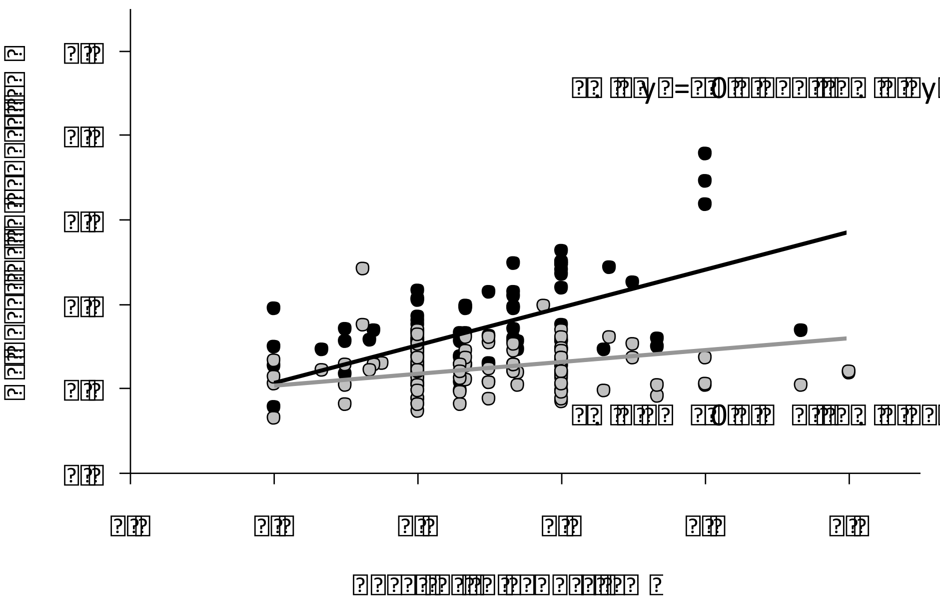
[illegible]

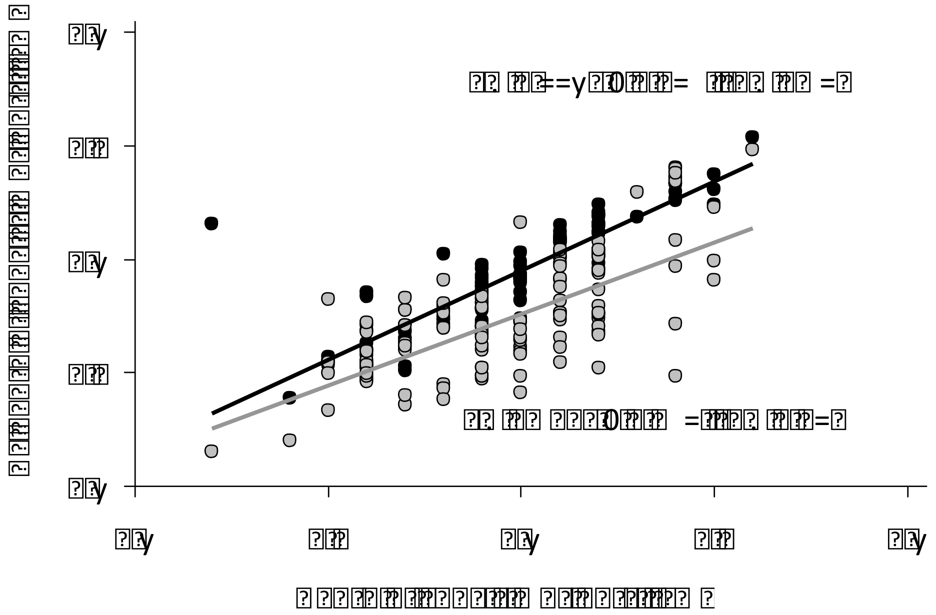
[illegible]

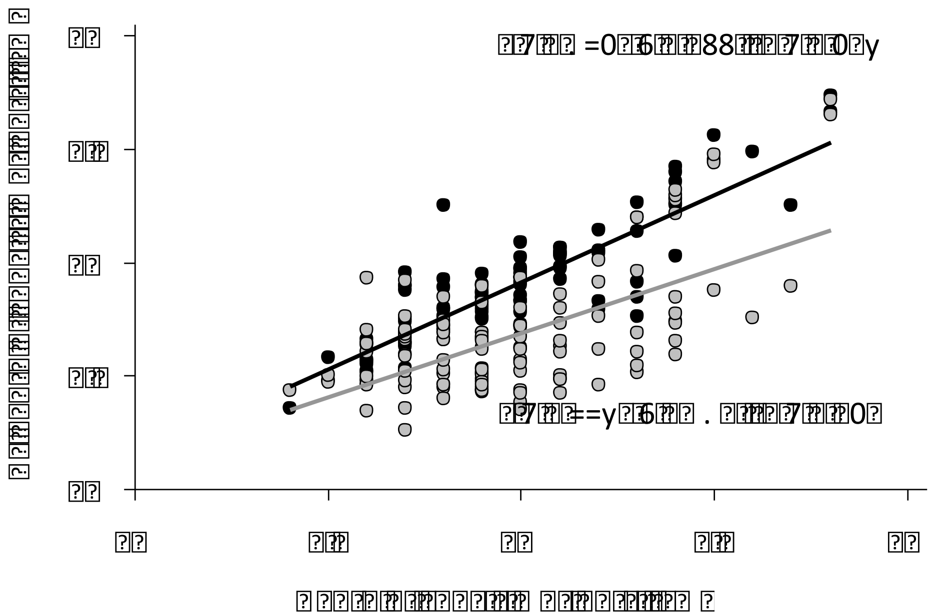
[illegible]

[illegible]

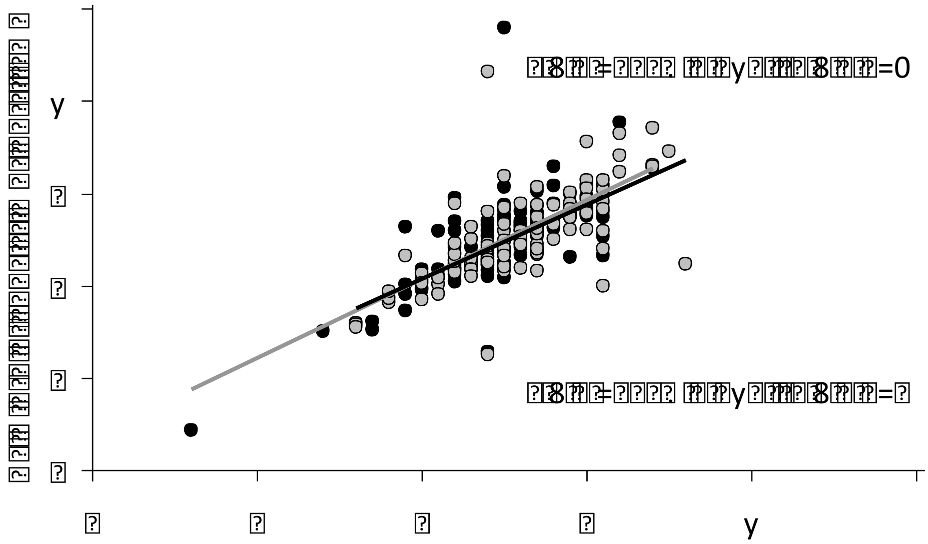




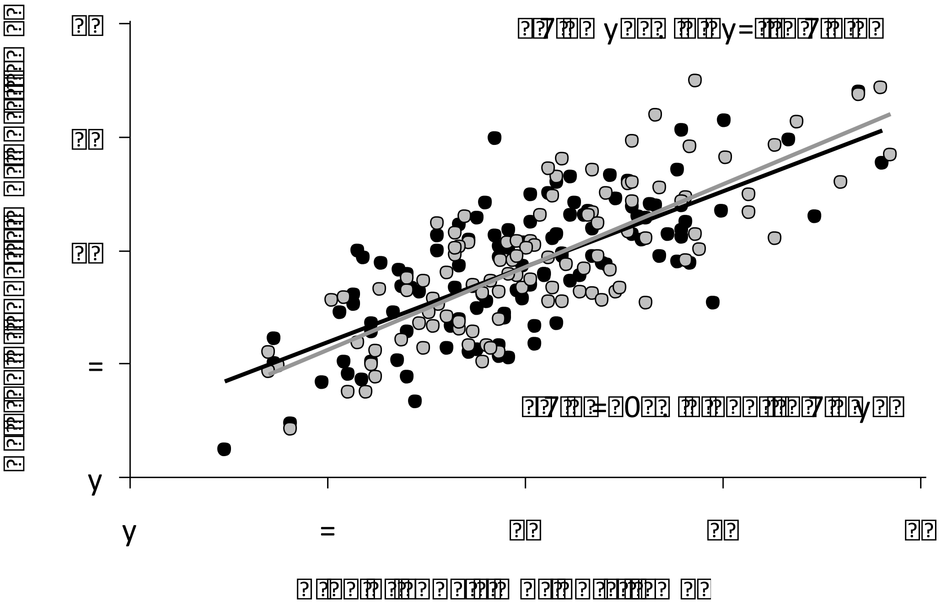




[illegible]



[illegible]



[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

B H c1 dm eb yec1 1es e lis cu ic mdmic eds b c di b sl c eb y l e i cc b c di b sl c el 1 ei 1 s db i mu m)

		eb yes sl c			
i 1[S]	ñ	P	4	R	-
ei 1 mu m					
[a]	q)qq9	q)qqR	q)qqñ	q)qqS	q)SRñ
	q)qS9	q)qqR	q)qqñ	q)qSS	q)Sñ9
	q)SñS	q)qqS	q)qqS	q)q88	q)P49
	q)8Pq	q)qPñ	q)S4R	q)HRP	q)8ñR
db i mu m					
	q)qSP	q)qq-	q)qqñ	q)qqR	q)SR8
	q)qñP	q)qq9	q)qqR	q)qSq	q)ñS9
	q)SP4	q)qqS	q)qqP	q)SPq	q)P-8
	q)HHP	q)SñP	q)SP4	q)RS-	S)q99

[S] d dl s edc aw l 1 as cc k B yl k B n 1 l k B s i k B e u m l n s Sñl s SPl l ei 1 u il i k ei 1 mu m ei n s Scl s ñs db i u il i kdb i mu m) [ñ] 5 b s cpd i yi 1 1es i iei) [P] 5 iiei e s li m s s g) [4] 5 iiei d e i cc1es) [R] 5 iiei d e 1 cl di s) 5 cl s i iiei e yi 1 1es)

c n em 2 id s cc e dmic eds n c umndl g s 2 u 1 s 1s b e i yl ldi c l l edm c1 g eii l g yy g1s y yieyi 1 eii l 1s leic s i i cc1es yie di c 2 i cy 1 u g) s l es li g 2 yel sl 1 m cedi c e u 1 1 g k)) 2 b i clil sl 2 n eem c 1s B b dcl a yl le l b 1s 1b db n s y y g1s dmic eds l s 1 pd c1s ei i le b 1s 1b 1 l i mu l 1b y l e) 1c es dc1es edm e cy 1 m i mu 1s l b c n i l 1 cb m i e g c1 c edm ei 1 1s l yieyeil 1es m g i l iiiei e b c di b sl ei li 1c l cb m yl c k eds a i 2S884B)

B B c1 dm eb yec1 1es e es 1 d 1s m dm i eds b c di b s lc eb y e i cc b c di b s lc el 1 ei 1 db i mu m)

		eb yes s lc			
i 1[S]		P	4	R	
ei 1 mu m					
	q)qSR	q)qSñ	q)qqñ	q)qqS	q)S9P
	q)q8R	q)qS4	q)qq8	q)qHñ	q)S8P
db i mu m					
	q)qñS	q)qS4	q)qqR	q)qqñ	q)S44
	q)SRS	q)Sq8	q)qS4	q)qñ9	q)PqP

[S] d dl s edc aw l 1 as cc k Bs yl k Be mu md l ln s Sñl s SPl ei 1 u il i kl ei 1 mu m ei ln s Scl s ñs db i u il i db i mu m) b s cpd i yi 1 l 1es i ei) ii ei e s li ms s g) ii ei d le i cc1 es) ii ei d le 1cl di s) cl s i ii ei e yi 1 l 1es)

i/ 1c s ml is 1u cl 1cl 1eb b es mg dc le um 1 l di g e dm i eds b c di b s lc 1s el i cy 1c dl s el 1s m c k b s 1c i l m)2 ñqSq B) s 1c cy 1c 2l ds 1pd i cdm 1m m 1s l c 1s l 1 m i di le um d l di g e dm i ceds b c di b s lc vy m s 1s l 1 i s l yel s l m cedi c e i c1 dm u 1 1 g e dc es g m c k i 1d m l m)2 ñqq8 B) m c m ce m dm m l is 1u cl 1cl 1 e um d l yi c1 es e l dm i eds b c di b s lc) c ei 1s l 1c cld g k m c -)R s -)- B n i c m l mg i i l l ec i yeil g el i l eic k 1l l m)2 ñqqR0 c l m)2 ñqq90 i 1d m l m)2 ñqq80 b s 1c i l m)2 ñqSq B2 m ed m g cb m m i l l b v1b db um d e q)ñR b cl m c g 1l l m) kñqqRB ei b c di b s lc 1s m b c) c ei k m c R s - B n i m n i l l um d c i yeil g i 1d m l m) kñqq8B) s l e 2l cdm 1s kq)PR q)PH b 2 ei m l 1es c2 cy l 1u mg B edm s el eb y c1 s i se yi u1edc cld 1c l i yeil l ei 1 c b c di b s l) ei 1s yi c s l cld g kq)8P S)q8 b ñ ei m 1es c2 cy l 1u mg B n m n i ec i yeil g 1 l m) kñqqRB kS)8ñ l e ñ)S9 b ñ B2 c l m) kñqq9B kS)RR b ñ B s b s 1c i l m) kñqSq B kS)9- l e ñ)ññ b ñ B2 cd cl 1s l edi dm i eds cl 1b c b ei dil l l ec e l 1s s i m i yeil c)

Capítulo 7

CARCASS TRAITS AND MEAT COMPOSITION OF LIGHT LAMBS

[illegible]

[illegible]

[illegible]

[illegible]

$$y_{ijk} = \mu + B_i + S_j + \varepsilon_{ijk}$$

[illegible]

G3 EG 1 D IN Hf B E1 G HBG B E B I1N G I3 Id IB E1 B H

C G D H C DE B 1 I t BG D H G E B 1 IB G E1 D N H 1G N DB H I H z d(D z d vf

HN G BG D HW G H1 HB d

[illegible] H B H L 1G N D Hq E BG D H G 1 IB G E1 D N H 1G N DB H B B EG C D 1N G I3 I EG F1 G C E II H D 1 D w D G E H G IN H

	C E II H	C E II H U 1 D	1 D
EG C 1 3 I			
f N	vd(6 q vd2	vd(6 q vd2	vd(z q vd2
f N	vd(z q vd;	vd(6 q vd2	vd(z q vd2
f N	.d26 q vd 0	.d0) q vd ;	.d0; q vd z
f N	0d00 q vd2)	0d66 q vdzk	0dz(q vd .
f N	kd6; q (d2v	kdk0 q (dv)	(vd(z q (d)
1N G I3 I			
f N	vd(6 q vd.	vd(6 q vd2	vd() q vd2
f N	vd(z q vdz	vd(z q vd0	vd() q vdz
f N	.d22 q vd .	.d0z q vd ;	.d(q vd22
f N	0d0) q vd0.	0dz; q vdzk	0d6k q vd2k
f N	kd k q (d2.	(vdv0 q (dvk	(vd6k q (d0k

p DH WCB B H N B GCD B H1 F GCD i C DE B C G HC DC C DB t 7 vd; vd TCD B CTD H vf H1 1B D E1 H T, B B CTD H vf FB vf WCB w D G w E

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible] H B [illegible] L 1G [illegible] N [illegible] D H [illegible] q [illegible] E [illegible] G [illegible] B [illegible] G [illegible] H H [illegible] N [illegible] H 1 G [illegible] N [illegible] D B H [illegible] B [illegible] B E G [illegible] C [illegible] D [illegible]
I1N [illegible] G [illegible] 1 [illegible] 3 [illegible] I H [illegible] E G [illegible] F 1 G [illegible] G [illegible] m C F E I I [illegible] H [illegible] D [illegible] 1 D [illegible] w [illegible] D [illegible] G E H H [illegible] G [illegible] N [illegible] H [illegible]

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Table 7.5 Light lambs *Longissimus dorsi* muscle intramuscular fat, fatty acid composition in percentage by weight of total identified fatty acids, and nutritional ratios[†].

		Ripollesa	Ripollesa × Lacaune	Lacaune
Intramuscular fat		$3.60^{a} \pm 0.37$	$3.23^{a} \pm 0.45$	$3.10^{a} \pm 0.29$
Fatty acid composition				
C10:0	Decanoic (Capric)	$0.13^{a} \pm 0.01$	$0.11^{b} \pm 0.01$	$0.11^{ab} \pm 0.01$
C12:0	Dodecanoic (Lauric)	$0.09^{a} \pm 0.01$	$0.08^{a} \pm 0.01$	$0.09^{a} \pm 0.01$
C13:0	Tridecanoic	$0.01^{a} \pm 0.00$	$0.01^{a} \pm 0.00$	$0.01^{a} \pm 0.00$
C14:0	Tetradecanoic (Myristic)	$2.03^{a} \pm 0.09$	$1.81^{a} \pm 0.07$	$1.97^{a} \pm 0.14$
C14:1	Tetradecenoic (Myristoleic)	$0.06^{ab} \pm 0.00$	$0.06^{b} \pm 0.00$	$0.07^{a} \pm 0.01$
C15:0	Pentadecanoic	$0.32^{a} \pm 0.02$	$0.31^{a} \pm 0.01$	$0.31^{a} \pm 0.02$
C16:0	Hexadecanoic (Palmitic)	$22.01^{a} \pm 0.36$	$21.61^{a} \pm 0.28$	$21.36^{a} \pm 0.37$
C16:1	Hexadecenoic (Palmitoleic)	$1.79^{b} \pm 0.08$	$1.95^{a} \pm 0.09$	$2.08^{ab} \pm 0.05$
C17:0	Heptadecanoic (Margaric)	$1.36^{a} \pm 0.08$	$1.41^{a} \pm 0.09$	$1.26^{a} \pm 0.04$
C17:1	Heptadecenoic	$0.80^{a} \pm 0.04$	$0.89^{a} \pm 0.05$	$0.90^{a} \pm 0.03$
C18:0	Octadecanoic (Estearic)	$14.74^{a} \pm 0.34$	$14.85^{a} \pm 0.48$	$13.27^{b} \pm 0.27$
C18:1	Octadecenoic (Elaidic)	$6.17^{a} \pm 0.45$	$5.57^{a} \pm 0.57$	$4.29^{b} \pm 0.36$
C18:1n-7	Octadecenoic (Oleic)	$37.34^{b} \pm 0.63$	$39.14^{ab} \pm 0.68$	$40.03^{a} \pm 1.09$
C18:1n-9	Vaccenic	$1.72^{b} \pm 0.06$	$1.79^{a} \pm 0.07$	$1.97^{a} \pm 0.15$
C18:2n-6	Linoleic (LN)	$4.26^{a} \pm 0.28$	$3.55^{b} \pm 0.27$	$4.37^{a} \pm 0.44$
tC18:2n-6	Linoelaidic	$0.23^{a} \pm 0.01$	$0.18^{b} \pm 0.02$	$0.23^{a} \pm 0.02$
CLA		$0.42^{a} \pm 0.02$	$0.40^{a} \pm 0.02$	$0.43^{a} \pm 0.02$
C18:3n-3	α-Linolenic (ALA)	$0.52^{ab} \pm 0.03$	$0.44^{b} \pm 0.03$	$0.59^{a} \pm 0.07$
C18:3n-6	γ-Linolenic	$0.06^{a} \pm 0.01$	$0.05^{a} \pm 0.00$	$0.06^{a} \pm 0.01$
C20:0	Eicosanoic (Arachidic)	$0.09^{a} \pm 0.00$	$0.09^{a} \pm 0.00$	$0.08^{b} \pm 0.00$
C20:1	Eicosenoic (Gadoleic)	$0.19^{a} \pm 0.01$	$0.18^{a} \pm 0.01$	$0.17^{a} \pm 0.01$
C20:2n-3		$0.04^{b} \pm 0.00$	$0.04^{b} \pm 0.00$	$0.06^{a} \pm 0.01$
C20:2n-6	Eicosadienoic	$0.07^{a} \pm 0.00$	$0.06^{a} \pm 0.00$	$0.06^{a} \pm 0.01$
C20:3n-3		$0.03^{a} \pm 0.00$	$0.02^{a} \pm 0.00$	$0.03^{a} \pm 0.01$

C20:3n-6	Dihomo- γ-Linolenic	$0.14^{ab} \pm 0.01$	$0.12^{b} \pm 0.01$	$0.16^{a} \pm 0.02$
C20:4n-6	Eicosatetraenoic (Arachidonic ARA)	$1.26^{a} \pm 0.10$	$1.29^{a} \pm 0.13$	$1.53^{a} \pm 0.15$
C20:5n-3	Eicosapentaenoic (EPA Timnodonic)	$0.18^{b} \pm 0.02$	$0.18^{b} \pm 0.02$	$0.23^{a} \pm 0.03$
C22:0	Docosanoic (Behenic)	$0.25^{a} \pm 0.01$	$0.29^{a} \pm 0.03$	$0.33^{a} \pm 0.05$
C22:1	Docosenoic (Erucic)	$0.01^{a} \pm 0.00$	$0.01^{a} \pm 0.00$	$0.01^{a} \pm 0.00$
C22:2n-6	Docosadienoic (Brassic)	$0.01^{b} \pm 0.00$	$0.02^{ab} \pm 0.00$	$0.02^{a} \pm 0.00$
C22:6n-3	Docosahexaenoic acid (DHA)	$0.09^{b} \pm 0.01$	$0.09^{b} \pm 0.01$	$0.12^{a} \pm 0.01$
C23:0	Tricosylic	$0.17^{a} \pm 0.05$	$0.13^{a} \pm 0.01$	$0.17^{a} \pm 0.03$
C24:0	Tetracosanoic (Lignoceric)	$0.02^{a} \pm 0.00$	$0.02^{a} \pm 0.01$	$0.02^{a} \pm 0.01$
SFA	Saturated fatty acid	41.19^{a}	40.70^{a}	38.99^{b}
MUFA	Monounsaturated fatty acid	48.10^{a}	49.59^{a}	49.53^{b}
PUFA	Polyunsaturated fatty acid	6.90^{ab}	6.04^{b}	7.45^{a}
Nutritional ratios				
PUFA/SFA		0.16^{ab}	0.15^{b}	0.19^{a}
n-6/n-3		6.96^{a}	6.84^{a}	6.27^{a}
C18:2n-6/C18:3n-3	LN/ALA	8.57^{a}	8.54^{a}	7.85^{a}

†The undecylic fatty acid (C11:00) was not reported because its average percentage incidence was lower than 0.01. a,b: Means with the same letter in the super index did not differ significantly ($p > 0.05$). CLA: isomer *cis-9*, *trans-11* C18:2; SFA: saturated fatty acids; MUFA: monosaturated fatty acids; PUFA: polyunsaturated fatty acids.

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Capítulo 8

DISCUSIÓN

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[illegible] u l Nre 91l 9ef eu9 o r lurS or lr Nr 1 l l 1u9 N 1 N1 ue N e rl 9í No9r 1uU 1 9 r lN li N ,lNe91í éjj xí éjj Éz 9l Du91 1 l rN1 1u91í éjj xz lNe91 u Ní éjj M rrl1 uN fí éjj áz N1 u Ní éjj qz D or uN fí éjj (z lN1 e uN fí éjj) z ee 1 uN fí éjj Éz lNe91 u Ní xyyy;í N 9 o9el IL1 n N l N le , b uN fí xyy);í e 1u 1 l u 9e e N IL1 n l e r N l1 9r IL1 9 u 1 l 1 N9e or9 r e U9r l 1u9 1 u 9f 9e 9 o91 1u e N 1 N rS e r 91el r 9e U 1u9 91 9u r9e u r e or9 l ua9e b e9 91L l 9r Na1 u e e N l1 9r IL1 Nr 1 l l 1u9 r l l 1u9í aN l IL1 alel N 1 9r IL1 N b l rS N u9 lel91 e e N IL1 1 N9e r 4 9ef l oN 1u IL1 N u 1 l l Nre 91l 9 u o9 r N or or lr Ne u rSeu e N 1 N n N 1í b r lur 9ru Nu o9 N orl e or9 1l b u r e N 1 Ní r le sl e 1 u 1 l 19 1ae la sl e ol r N li 1 N1 l N 1 ala9 n N9e 9e N 1 N bl 1 e r 9N u 9e 1 l 1 o9 N IL1 9r l N e ol rS n r 4 9e 9 r IN e, lN eí xyyé;f

[illegible]

l 1sl Nr leur9 N9e 9e or N 91ur9N r 1 l l 1u9e r or e 1u l 1 u e b r N boN9u l91 e 9al1e íu 1 1 r1 o9ru l or N9e 1 r9e n sl br9o9r l91 l 1r leur9 br le9 u9 9 N9 sl el 1 Nr 4 9í b r lu 1 9 u9 r N l e n l91 e l e 1 e 9 1 e l9f e or9o9r l91 l1 9r IL1 u1 u9 br9 l ua 9 9 1 N L l N l N 1 1 a i 1N li n ol r 19e o r lu br lr NaN 9r 1 u 9 N9e 1 l N e b N9e u r e 1u r eí el or n l 1 9 N D r lN N9e le 9e e 9r r9f eu9í el a ií b r lu l1 r Ne lel91 e r r 1u e N e N IL1 1l a9e l1 lal l 9e r o9el IL1í e S 9 9 e N l91 N9e U9r e 1 l 9e b 1ur N 1ur9 u eU 9rl 9e N r 9al1 lo9N e N9e l N e u N 1u e e N l91 u9 1 9 1 l 1u N or9N hN 9r 9 N9 S l rl 1 9 91 Ne r u rSeu e N eu1 IN f

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N esl e N IL1 N r lo9N e D orl9rli 9 e N orl r 9 1u9 N U9r N or9N íe S 9 9 N 1 u1l l 1u9 N e u rSeu e 9r 9N l e 1l e 1 N eu1 INí el 1 9 el or N9 Uua9 1N N esl

[illegible]

[illegible]

Capítulo 9

CONCLUSIONES

[illegible]

[illegible]

[illegible]

tu [illegible]

xu [illegible]

pu [illegible]

[illegible]

nu [illegible]

bu [illegible]

j u [illegible]

[illegible]

, u [illegible]

i u [illegible]

v u [illegible]

[illegible]

t s u [illegible]

t t u [illegible]

[illegible]

BIBLIOGRAFÍA

[illegible]

[illegible] nRAayh. 8[illegible] Xj j j [illegible] 9A [illegible] RA2Amht , A. i [illegible] h1 [illegible] y4yiA, [illegible] h1 [illegible] l. Aa [illegible], Ay [illegible] uaA, A. iy [illegible] ih [illegible] tah2lRA [illegible]

[illegible] yAyy, A. i [illegible] h1 [illegible] 4t A [illegible] R [illegible] 1u. Ol lh. [illegible] h1 [illegible] LAA1 [illegible] inAw [illegible] (“3 [illegible] é“P““w

[illegible] nA: [illegible]. RAa8 [illegible] w [illegible] iA2A. y8 [illegible] lr6hua8 [illegible] RA [illegible] 6A. 8 [illegible] hiiAay9AR 8 [illegible] R [illegible] 4. O9 [illegible] Xj W/ [illegible]

[illegible] At [illegible] ilh. [illegible] h1 [illegible] A5 Ay [illegible] 1ah, [illegible] 5 l. [illegible] Ly3 [illegible] OlRA. OA [illegible] l. [illegible] yA2Aa [illegible] y9AAt [illegible] LaAARyw [illegible] ttnw [illegible]. l, [illegible]

[illegible] i9hnw [illegible] Xí 3 [illegible]) í XP) Xòw

[illegible] n1h. yh8 [illegible] w [illegible] uRh8 [illegible] Aa6A8 [illegible] ly9Aa8 [illegible] i, [illegible] ly8 [illegible] 9haoAnyyh. 8 [illegible] R [illegible]

[illegible] ly A. ilAaw [illegible] (í í Xw [illegible] 1nuA. iln [illegible] ihay [illegible] l. [illegible] L [illegible], A [illegible] fun [illegible] li4w [illegible] OOAti [illegible] LlnIi4 [illegible] h1 [illegible] ytAO1lO [illegible]

RAyl6. [illegible] lh. yw [illegible] ahRuOl lh. [illegible] y4yiA, [illegible] R [illegible] tahRuOl [illegible] fun [illegible] li4 [illegible] l. [illegible] y9AAt [illegible] R [illegible] 6h [illegible] yw [illegible] tilh. y [illegible]

, ARliAaa [illegible] AA. . Ay8 [illegible] yAalA [illegible] é”3 [illegible] Xj P(Ww [illegible]

[illegible] nA. 8 [illegible] R [illegible] hA6ARl. 6w [illegible] Xj WXw [illegible] h, A [illegible] tlR [illegible] O9 [illegible] iAalyilOy [illegible] R [illegible] l. iAa [illegible] ilh. [illegible] l. [illegible], uyOnA [illegible]

1hhRyw [illegible] aA2lA5 w [illegible] hhR [illegible] AO9. hnw [illegible]) “3 [illegible] (“) P(“òw [illegible]

[illegible] n2 [illegible] A-8 [illegible] w [illegible] aAy. h8 [illegible] thiA8 [illegible] An6R h8 [illegible] R [illegible] L [illegible] (í í í w [illegible] yiuRlh [illegible] t [illegible] n [illegible]

O [illegible] a [illegible] O AaI- [illegible] Op. [illegible] RA [illegible] a [illegible] h2l. [illegible]. [illegible] lw [illegible] aO9l2hy [illegible] RA [illegible] hhiAO lw [illegible] é j 3 [illegible] (í j P(X“w [illegible]

[illegible] n2 [illegible] A-8 [illegible] w [illegible] aAy. h8 [illegible] thiA8 [illegible] An6R h8 [illegible] R [illegible] Lw [illegible] (í í í Lw [illegible] yiuRlh [illegible] t [illegible] n [illegible]

O [illegible] a [illegible] O AaI- [illegible] Op. [illegible] RA [illegible] a [illegible] h2l. [illegible], Aaw [illegible] aO9l2hy [illegible] RA [illegible] hhiAO lw [illegible] é j 3 [illegible] (XòP(((w [illegible]

[illegible], l. 8 [illegible] Xj j “w [illegible]. [illegible] l. iahRuOl lh. [illegible] h [illegible] tal. Ot nAy [illegible] h1 [illegible] uniay hu. Rw [illegible] h5 [illegible] i [illegible] A [illegible]. l2Aayli4w [illegible] iuR4 [illegible]

[illegible] ulRAw [illegible]

[illegible]. RAayyh. 8 [illegible] Xj j éw [illegible] A: un [illegible] yAnAOl lh. w [illegible] al. OAih. [illegible]. l2Aayli4 [illegible] aAyyw [illegible] al. OAih. [illegible] t w [illegible] ‘j j w [illegible]

[illegible]. p. l, hw [illegible] Xj j Xw [illegible] AyhnuOp. [illegible] RA [illegible] X) [illegible] RA [illegible] 1ALaAah [illegible] RA [illegible] Xj j X8 [illegible] yhLaA [illegible] aA6n [illegible] A. i [illegible] lp. [illegible] RAn [illegible] Lah [illegible]

6A. An [illegible] p6lOh [illegible] RA [illegible] a [illegible] 2l. [illegible] lthmAyw [illegible] XéX) 3Xí (XPXí ( ) w [illegible]

[illegible] t [illegible] lOh8 [illegible] Xj éé w [illegible] hhiAO l [illegible] ytAOn 3 [illegible] Ai. hnh6d [illegible] Oh, tA. RlR w [illegible] aRhLw [illegible] Rw [illegible] An [illegible]

RA [illegible] paRhL [illegible]) ”é [illegible] t w [illegible]

[illegible] uahuyyA [illegible] 8 [illegible] Xj WXw [illegible] ha [illegible] lh. [illegible] RAy [illegible] tlRAy [illegible] Ohat ha [illegible] y [illegible] Ai [illegible] 2 [illegible] Aua [illegible] RAy [illegible] O [illegible] O [illegible] yAy [illegible] RAy [illegible]

au, l. [illegible] iyw [illegible] un [illegible] AO9w [illegible] 9Al: w [illegible] é“3 [illegible] é) P”í w [illegible]

[illegible] uahuyyA [illegible] 8 [illegible] w [illegible] O9 [illegible] a8 [illegible] aA8 [illegible] hi8 [illegible] a [illegible] 9A8 [illegible] lOhn8 [illegible] R [illegible] alhnhw [illegible] (í í òw [illegible]

[illegible] Rhha [illegible] iiA. l. 6 [illegible] h1 [illegible] Ly [illegible] yAR [illegible] h. [illegible] ty iuaA3 [illegible] XÁ [illegible] 1nuA. OA [illegible] h1 [illegible] yi [illegible] n [illegible] l. ly9l. 6 [illegible] Rua [illegible] lh. [illegible]

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1 iiA. l. 6 h1 m, Ly al yAR h. t y iuaA3 d(Á 1nuA. OA h1 yin m1. ly9l. 6 Rua lh. h.
ial6m4OAalRA . R t 9hyt 9hntlR 1 i4 O lRyl. 9A 9haO ly, uyOrAw A
Olwo" 3 éXòPé(òw

2Am Ai8 w(í í " w h. yAa2 O lp. RA aAOuayhy 6A. ÍilOhy h2l. hy A. m a lyf uAi3
O a Ol Aal- Olp. AyiauOlua m8aO lm 4 6Ayilp. RA m Rl2AaylRR A. tah6a, y 7l. yliuCw
Ayly hOlha mw . l2Aayli i uiv. h, RA a OAm. w

hy8 w8 w l66 y8 R w h5 Amw(í í Xw , t O i h1 t Aa. li4 Aaahay l. Oh5
lRA. il1lO lh. h. 6A. AilO A2m u lh. y R . iAa. lh. m Oh, t a lyh. yw a4 OlwWé3
(" ( ) P(" (j w

a h. A8 w w w8 w hm iau6nlh8 w lahm, l8 w y yl. h8 R wumhw(í í òw A. AilO 4t A8
yA: 86 A ym 69iAa R 1AARl. 6 y4yiA, A11AOly h. Oa O y R Oui Oh, thylilh. l.
m, Lyw l2Ayiw OlwXX(3 X)) PXé(w

AR9l1 h, R9 l8 w8 R w sA, m lw(í í " w yil, lh. h1 y9AAt Oa O y ia iy L4
unia y hu. R AO9. hm64w l2Ayiw ahRw OlwXí X3(j éP(j j w

Amh18 w8 R w m 1w(í í éw At hylilh. h1 tahiAl. 81 R A. Aa64 l. m, Ly h1 9A LaAAR
Aa, . Aal. h Ry9AAt w . l, w OlwòW) " j P) òWw

A. R sh uR8 w8 R wWw 2Aa6. AwXj j Xw h, t a yh. RA Xé aO Ay h2l. Ay 1a G yAy
m ihO9ih. Ay ta 0d RlOA R aO9 ey, Aw ahRuOlh. y . l, mAywé éÁ) (XP) (Ww
A. il8 w8 w Anuyh8 w lOhm 8 . R w n2 lw(í í éw hr4u. y ua AR i4 OlRy3
lhO9A, lOh 8 uialilh. m . R tl6A. AilO ahtAailAyw , w hmw uiaw( ) 3(WXP) í (w

A. O9 a 8 w8 w l2Ayi8 w h, a 8 R w 9lf uAiiAw Xj j Ww aARlOlh. h1 , Ai9 A
tahRuOlh. 1ah, R la4 Oh5 y uyl. 6 A: lyil. 6 , AO9 lyilO , hRAmy R aA6aAyylh.
Af u lh. yw . l, w Olwò" 3" XòP" (òw

A. lih8 ww(í í òw Rl1dOlmylíuO lp. RAm h2l. h RA Oa . Aw 6alOuniua , lma A. yt TWw
. lp. RA Af uAThy 6alOunihaAy4 R Aahyw R alRwt tw(éXP(ééw

Aal l. 8 vwv R vl-y hvXjjòvn lRR RA n Oa . A RA 2O u. hv . 7 O u. h RA Oa . A3 y tAOlhy Oh2 AyCv u: R Í v Rv u. RlP aA. yv R alRv tv éj) P“Xív

Aa. l Íu8 v8 R v A. RAahv (íí“v aA1AaA. OA yiauOluaA 1ha y L , A Oh. yu, Aayv t . ly9 O yA yiuR4v A OlvòX3 é”éPéòív

hAa8 v A8 v u, h. i8 v v h, Aah48 R v v A. l6Aav Xjòév u h. v v v v aA1AaA. OA , Ai9hRy 1ha 9A y yAyy, A. i h1 Oa Oy y O9a O iAalyilOy l. O inAv l2Ayiv ahRv OlvX3 X“XPX”év

h. . h, A8 v8 R v v au. 4v XjWòv iAa lO O lR RhAy hi a yA yAau, O9hnAyiAahnv n l. v Ayv)“3)” “P)”jv

hiol. 8 v v8 v v lAnR8 R v v h9. yh. v XjWWv 9AAt R hhn3 OA. OA8 ahRuOlh. . R 6 A, A. iv R aA. ilOA n n4 v v . 6nA5 hhR n11yw

aR 1haR8 v v Xjjjv h. ialLuilh. y h1 l, n 6 alOuniuaA h , AAil. 6 6nhL n 9u, . 1hhR RA, R l2Ayiv ahRv Olv j3 j“PXX(v

a yO9AlR8 v (íí)w uahtt Oh, h Oh. yu, lRha 4 tahRuOlha RA Oa . Av A. iah ARAan RA 2Ayil6O lp. yhLaA n Oa . Av . v

aARh. 8 v v8 v v iA5 ai8 R v v u6, haAv XjWòv uialil2A 2n uA R O9A, lOn Oh, thylilh. h1 Oh, , h. n4 uyAR hui9 1alO 1a , 1AARyv v8 n A6lh. 8 Atai, A. i h1 6alOuniuaA R Aa uttn4v 5 unuP in A6lh. v

uOonA48 v v8 v v haalyA48 R v a 4v Xjj“v 1nuA. OA h1 RlAia 4 2li l. h. 9A h:lR l2Ayi LlnIi4 R fun li4 h1 tl6 , A iv . l, v Olvò) 3)X((P)X)ív

u. OA v v8 v v hu698 R v v hhaAv (ííév Ay uaA, A. i h1 Rh, l. n , uyOnA i9lOo. Ayy uyl. 6 P, hRA unia y hu. R , 6 l. 6 Rual. 6 1u. Olh. n O il2lilAyv un 9Aa 4v j3 éXVéév

u: R Í v Xjj”v hhiAO l8 Ly Ay RA tahRuOOlp. l, n v h, h 3 ahRuOOlp. h2l. v Rv u. RlP aA. yv R alRv)WX tv

s 8 v8 v O 98 v lARa1 li8 v lnB. 8 R v y Any v (íXív lthnAyv Ay a OAy ipOlh. Ay O n Ay hyylAa FO lOu é)3 XòP(ív

□□ □□□ vx□□ v□□O 9□□v□□lARa□ li□□v□□u1d□□ R□□v□□y Amy v□(ííj v□□Aa1ha, □ OA□h1□9A□□lthmAy□ y9AAt□LaAAR□u. RAa□OuaaA. i□tahRuOlh. □y4yiA, y□l. □□ m h. lv□□□□□□□"íi9□□. . um□ □AAil. 6□□□ OAmh. □v□□ □ A. l. 6A. □□O□ A, lO□□uLmly9Aay□□9A□□Ai9Aam□ Ryv□□"v□t v□

□□aRhyh□□v□□ R□□v□□A, tAn, □ v□(íí) v□□4 Ayl□ □l. 1AaA. OA□h. □6A. AilO□, Aali□u. RAa□ u. OAail□. □t□ Aa. li4v□□A. Aiv□□Anv□□2hmv□ "3□é" j Pé Wòv□

□□aalm9h□□ v□v□□ v□□ptA-8□□ R□□ v□ v□□□, thv□(ííj v□□11AO□h1□i9A□1□ iA. l. 6□RlAi□h. □i9A□ RA2Amht, A. i□h1□9A□1□ i4□O lR□tah1mA□l. □□□ Lliy□1ah, □5 A□ l. 6v□□ A□ □□Ov□□\"3□WWj "v□

□□y□ h2□ □v□□v□□AaaAi□□v□□ Od□□ R□□v□□, h. v□Xj W"v□□yiuRlh□-hh, ÍialOh□aA□ l-R h□Oh. □ h2l. hy□RA□□ □ □lthmAyv□□a: luy□RA□□O□□□□v□□u□ai□ □FalAv□ò3□) Péív□

□□yAmy 8□□v□(íí" v□□ lmlha□□6A. FilO□ RA□□tahRuOl2li□ □u, FalO□ A. □h2l. y□RA□□G □alt hmAyv□ □Ayly□□hOlham v□□. l2Aayli□ □□uiv. h, □RA□□□ OAmh. □v□

□□yAmy 8□□v□□v□□□□ □□v□□AaaAi□□. R□□v□□lARa□ li□v□(ííòv□□. m 4yly□h1□hiiAa□yl-A□□ R□R4 y□h□ m□, Ll. 6□. □9A□□lthmAy□ A5 Av□□□□h, t□ lyh. □h1□, hRAmy□5 li9□l. Aa□ □□ R□9aAy9hmR□ □ tahO 9Ayv□□□□. l, v□□Ov□□\"3"XWP"(éw

□□yAmy 8□□v□□v□□□□ □□v□□AaaAi□□ R□□v□□lARa□ li□v□(ííòLv□□. m 4yly□h1□hiiAa□yl-A□□ R□R4 y□h□ m□, Ll. 6□l. □9A□□lthmAy□ A5 Av□□□□yil, □lh. □h1□2□ l□. OA□Oh, th. A. iy□□ R□aAyth. yA□h□ t9A. hi4tlO□yAmAOlh. □h. □hiiAa□yl-Av□□□□. l, v□□Ov□□"3"("P") Xw

□□yAmy 8□□v□□v□□□□ □□ R□□v□□lARa□ li□v□(ííòOv□□A. AilO□RAiAa, l. ly, □1ha□5 li9l. PhiiAa□Llai9□ 5Al69i□2□ l□lh. □□ R□liy□aAm□lh. y9lt□5 li9□hiiAa□5 Al69i□□ R□hiiAa□yl-A□l. □9A□□lthmAy□ A5 A□LaAARv□□. l, m v□X3□") òP"éév□

□□yAmy 8□□v□□v□□□ □□□v□□uO9□□ R□□v□□lARa□ li□v□(ííòRv□□ua2l2m □□ m 4yly□1ah, □Llai9□ih□ ym□ 69iAa□h1□□lthmAy□ m□ Ly□u. RAa□yA, lPl. iA. yl2A□, □ □ A, A. iv□□□□. l, v□□Ov□□"3□ "X(P"Xòv□

□□yAmy 8□□v□□v□□lARa□ li□ □□v□□□ □□ □□ R□□v□□ h. □v□(ííj v□□. m 4yly□h1□1hu. RAaPyt AO1lO□ l. LaAARl. 6□RAtaAyylh. □h. □Llai9□5 Al69i□l. □□lthmAy□ m□ Lyv□□□□. l, v□□Ov□□ò3□(Pòj v□

□□yiah□□v□□v□□ □ yh□□v□v□□ □ iAOp. □□v□□ulam 8□□ R□□v□□l, A. hv□(íí"v□□□ii4□O lR□ Oh, thylilh. □□ R□O□aOy y□O9□ O iAalyilOy□h1□6ah5l. 6□□□ Ly□1AR□RlAiy□Oh. il□. l. 6□ t□n, □hlm□yuttmA, A. iyv□□ A□ □□Ov□"j 3□"òPò"év□

□hLhy8□□v8□□v□RA□h□ □h-8□□ v□□□, LAah8□□ R□□v□v□□aRhTA-v□Xjjév□□A2lylp. 3□□ 1nuA. O□□ RA□h□□

RlAi□ □ l, n□□A. □hy□BORhy□6a□ hy□RA□hy□nd lRhy□RA□h□ O□ . Av□□A2lyi□ □yt□ h□□RA□

□lA. O□□4□□AQ hn6d□ RA□□nl, A. ihy□)é3□)“P”Xv□

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□a□ Aa8□□v□v□Xj”(v□□A. AilO□□ R□A. 2lah., A. in □A11AO□h. □1□i□Ch, thylilh. □h1□□ Lyv□□ahOv□

□AOtv□□ A□ □□h. 1v□X“3□Xò)v□

□□-□8□□v□Xjjòv□□AtahRuOOlp. □4□ylyiA, y□ □RA□A:tnhiO lp. □RAn□6□ R h□h2l. hv□□Rv□□ u. RlP

□aA. yv□□ R alRv□)Vé□tv□

□□-□8□□v□(íí(v□□ Asha□ RA□h□ tahRuOl2lR□ □4□tn□ l1lO□ lp. □RA□A:tnhiO lh. Ay□h2l. y□ v□□Rv□

□6adOhn□ □yt□ThnB □□v□v□□ R alRv()(tw

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□ R□□□□□□□□□ □□□□□□□□□, uyOnA□RAti9□1ha□taARlOl. 6□O□ O□y y□Ch, thylilh. □h1□n2A□

□a6 h. □□ Lyv□□, n n□□u, l. v□□Ayv□X”3X“jPX”éw

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□ua. hny8□□v□□ h. ihyyl8□□v□□□ □□unlB. 8□□v□v□□uiA8□□ R□□v□□□ AfuAv□(íí“v□□□ii4□□O lR□

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unia□ h. lO□, Ay uaA, A. i□ h1□ 1□ □i9lOo. Ayy□ □ R□nh. 6lyly, uy□, uyOnA□a A□3□ □w□
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unia□ hu. R□, Ay uaA, A. iy□h1□1□ □9lOo. Ayy□□ R□h. 6lyyl, uy□, uyOnA□a A□ l. □1AARnhi□
O□iinA3□yyAyy, A. i□h1□□ Oua□ 4□□ R□aAtA□ □ lnli4w□□ w□□w□□. l, w□□Olw□W3□(òòP(W′w□

□y il. 6y8□□ w□w□Xjòíw□□ h. iA□□□anh□y□, tnl. 6□, Ai9hRy□uyl. 6□□ a oh2□O9l□. y□□ R□i9Ala□
□ tnlO□ lh. yw□□lh, Aialo□“ò3□jòPXíjw□

□ARalOo8□□w□w□Xj W)w□□ Ai9hRy□h1□Ayil, □ l. 6□nl2A□□ l, n □□ R□O□aOy y□Oh, thylilh. w□□w□□. l, w□
□Olw□′ò3□X)X”PX)(òw□

□A6□i48□□v□v□8□□v□□9□ Ry8□□v□□ □aO9□ i8□□v□v□□htol.y8□□v□v□□□n□□ R□□v□□□ RA.v□(íí"v□□11AOly□ h1□□2□ m□ mA□.uialilh.□□ R□ylaA□LaAARl.6□2□uAy□1ha□6ah5i9□□ R□, uyOh.6□h.□i9A□ RA2Amht, A.i□h1□OahyyLaAR□□ Lyv□X3□□ah5i9□□ R□O□ O□ y□O9□□iAalyilOyv□□uyiv□□v□ □6alO□□Ayv□"ò3□"j)P"í)v□

□A6yiAR8□□v□ v□□v□v□□ O□□ R48□□ v□v□□4Aay8□□ R□□v□v□□ia AvoXj""v□□u□.ilil□l2A□A11AOly□h1□ RlAi□4□1□□h.□yAau, □O9hnAyiAahn□l.□, □.v□□, v□□v□□nl.v□□uiav□Xò3□(WXPj"v□

□A.RAayh.8□□v□v□Xjò)v□□laA□A2□u□lh.□□ R□6A.AilOnaA.Ryv□□ahOv□□.l, v□□aAARv□□.R□□A.Aiv□ □4, tv□l.□□h.ha□h1□□av□□v□v□□uy9v□□□□□v□□9□, t□6.v□□□□v□tv□Xí PéXv□

□Aa, □.yA.8□□v□□□v□□l.AyA.8□□v□v□□hlA8□□v□□ ha6A.yiAa.8□□ R□□v□□auA.5□ Rv□(íí)v□□11AOly□h1□ yh4□□ R□hi9Aa□.□uan□tahRuOly□h.□□□□3□□□□a□lh□□ R□hi9Aa□htlR□ta□, □ AiAay3□□ nliAa□uaA□A2lA5v□□R2w□9Aav□(í3"íPòWw

□AaaAa□8□□ v□(íí)v□□aliAalhy□Ai.h-hhiÍO.lOhy□ta□□□RA1l.lOp.□RA□thLn□O lh.Ay□□ l, □Ayv□□□ □h.6aAyh□RA□n□ □hOARR □□ytT hn□ ta□ □ nhy□□AOuayhy□□A.ÍilOhy□□.l, □Ay□4□□□□ □h.6aAyh□□LÍalOh□yhLaA□□AOuayhy□□A.ÍilOhy□□.l, □Ayv□□lLah□RA□□Oly v□□R alRv□

□AaaAa□8□□ v□□v□□hRAah8□□ v□v□□uilÍaaA-8□□v□□AT8□□ R□□v□ v□□hRAahv□Xjj"v□□ttnlO□lh.□h1□ , unil1□OhalnR□RlyOal, l.□ i□□ □4yly□l.□i9A□, hat9hyiauOuan□Rl11AaA.il□lh.□h1□ □.R□uyl□ □O□ al.A□LaAARyv□□, □n□□u, l.w□Ayw((3□)jPéòw

□Aaal.68□□v□v□□ R□□v□□sha.ih.v□XjW'v□□94ylOy□1□Oly□□ R□ail1□Oly□h1□Rl□.hyilO□unia□ hu.Rv□ □3□□9A□□AiAal.□ 4□Oh.lOy□h1□□hai9□□, AalO□P□, □n□□.l, □□□a□ilOAv□□ v□□v□□□.RAay□ □hv□□□9lnR Ant9l8□□□v□tt□XXíòPXX((v□

□Aaal.68□□ v□v□□v□v□□alAyA8□□v□v□□Aaia□ R8□□ R□□v□□ahuO9v□Xjj W□□h, ta□lyh.□h1□1hua□aAn□l, A□ unia□ hu.R□y4yiA, y□9□□taARlOl□.ia, uyOun□□1□□.□LAA1□O□inAv□□v□□.l, v□□Olv□ò"3□)"éV)òív□

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□htol.y8□□v□v□□ R□□v□ v□□h6□i4v□XjjW□□l2AayA□□ L□6A.hi4tAy□k Xv□□lAnR□h1□ynAL□ mA□Ouiy□ □ R□, A□□l.□9A□O□ O□ y□□.R□9A□taARlOlh.□h1□4lAnRv□□ A□□□Olv□éj3□é"jPéò"v□

□htol. y8□□ww8□□ww□w□□ n r8□□ R□□ ww□ u11w□Xj j ”w□□, L□O□ O□ y□O9□ □ i AalyilOyw□)w□□ AyOaLl. 6□ O9□. 6Ay□l. □O□ O□ yAy□h1□6ah5 l. 6□□ Ly□uyl. 6□aA□ Pil, A□unia□ hu. R□□ R□9A□uyA□h1□ i9A□, A□ uaA, A. iy□1ha□Ayil, □ l. 6□9A□4lA□R□h1□y□ A□ □A□, A□ w□□uyiw□□w□:tw□□6alOw□)”3□)òPé)w□

□htol. y8□□ww8□□ww□□u118□□ R□□w□w□□ ha6□ w□Xj j Ww□□A□ □il, A□unia□ hu. R□□ R□O□ O□ y□ , A□ uaA, A. i□h1□1□ □RAti9□□ R□, uyO□A□Rl, A. ylh. y□□ □i5 h□yliAy□l. □□ Lyw□□. l, w□ □ahRw□□uyiw□(3□X“òPX”íw□

□hu69ih. 8□□ww8□□ R□□w□ w□□umn□l. 6ih. w□Xj j (w□□ttnlO□ lh. □h1□unia□ hu. R□1ha□1AARl. 6□□ R□ 1l. ly9l. 6□□ l, □ y3□□ aA2lA5 w□□w□□. l, w□□Ow□í3□j)íPJéXw

□uy□l. 8□□ww8□□ww□□ hn18□□ R□□ w□□ □ Ayl6. w□(íí”w□□A. AilO□t□ □, AiAay□h1□□ L□5 Al69iy□□ R□ unia□ h. lO□, uyO□A□□ R□1□ RAti9y□l. □□Aun□ □□tAOonA1□□ AR□y9AAtw□□, □ n□□u, l. w□□Ayw□ òí3□XX”PX()w□

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□□□ w□□ yiliuiA□h1□□ ARlOl. Aw□(íí(w□□lAi□ 4□aA1AaA. OA□l. i□ Ay□1ha□A. Aa648□O□ Lh94Ra□ A8□ 1lLAa8□1□ 8□1□ i4□□ lRy8□O9hnAyiAahn8□tahiAl. 8□□ R□□, l. h□□ lRy□, □ ah. uialA. iyw□ □ □y9l. 6ih. 8□□w□w3□□ □ n□□OR A, lAy□□aAyyw□tt□((V“éXw□

□yaA n8□□w8□ R□□w□□ AnnAaw□(ííí w□□11AOl□h1□, lylRA. il1lO□ lh. □h. □6A. AilO□6□. □□ R□Ayil, □ lh. □h1□ LaAARl. 6□□ uA□l. □R□ a4□O□ inA□ht un□ lh. yw□□w□□ □ a4□□Ow□V3□XVXVXVòw□

□haR□ □8□□w8□□ R□□ w□□lLpw□Xj j Xw□□A□□ lh. Ay□1ln6A. ÍilO□y□A. iaA□a□ □ □h2l. □ □Ayt□ hn□ □ hLiA. lR□ □□ t□ ila□RA□Ayi uRlh□RA□O□ □ iAaAy□, ha1hn6lOhyw□□ 2Ayil6□ lp. □□6adOhn□3□ □ahRuOOlp. □4□□ lR□ □□ l, □ w□’o)Á3□(“P()òw□

□A. . AR48□□w□ w8□□w□w□□O9□A11Aa8□□ R□□w□w□□haA. yA. w□Xj VWw□□A. AilO□taht AailAy□h1□□ l, □ □ , hRAnyw□□ahOAARl. 6y□h1□9A□□ l, □ □, hRA□5 haoy9htw□□w□□ □la4□□Ow□X□□ut n□3XòP(”w□

□A4y8□□w8□□w□□ A. hiil8□□ w□w□□ □ 2h. A. 8□□w□□a2 □. ly8□□w□□n□OoLua. 8□□w□□u-l. □8□□w□w□□shaRsA2lO8□ □w□w□□h. iy□ 8□□w□□l□. -□8□□ w□w□□A4y8□□w□□ah, 9hui8□□w□□ARAnsoh2lO8□□w□□u. ya□ 8□□w□ □AOO□ AOOl□8□□. R□□w□□hy9l, w□Xj W’w□□9A□RlAi□□ R□X“P4Aa□ □RA□ 9□a□ A□l. □9A□yA2A. □ □hu. ialAy□yiuR4w□□. . w□□w□□tlRA, w□X(é3□jí)PJX“w□

□. □tt□□w8□□ R□□w□w□□hhow□Xj))w□□Oh, t□ lyh. □h1□LhR4□, A□ uaA, A. iy□h1□LAA1□□ R□Run□P tuathyA□O□iinAw□□w□□. l, w□□Ow□X3□òPWéw□

[illegible]u. A. A8[illegible] Ay, 2u. l8 R[illegible]hyyA4[illegible](ííò[illegible]9a iAal-[illegible] lh. h1[illegible]unu[illegible]6u. lÁy9AAt uyl. 6[illegible]h. Aa LhR4, Ay uaA, A. iy R[illegible]yh, A. 2lah, A. i[illegible] ihay 1ACl. 6 9AyA , Ay uaA, A. iy[illegible]hui9 1alC [illegible]. l, [illegible]C[illegible]) ò3[illegible]XXP(í[illegible]

[illegible]2, A8[illegible] R[illegible] 6A. [illegible](ííò[illegible]AnACl lh. 1ha[illegible]A 5 Al69i L yAR[illegible]h. uniay hu. R R[illegible]l. , A [illegible]l. A[illegible]h1y9AAt [illegible]l2Ayi[illegible]C[illegible]Kí”3[illegible])(V(é([illegible]

[illegible]5 alA8[illegible]Xjj W[illegible]lA. Cl RA[illegible]C[illegible]. A[illegible])a [illegible]RlC[illegible]Rli[illegible]C[illegible]LlB [illegible] h-[illegible]qyt Á [illegible])”ò t[illegible]

[illegible]A[illegible]. C8[illegible] [illegible]Ayi[illegible]P[illegible]l C9Ai8 R[illegible]ha6A. yh. [illegible](ííX[illegible]A:u[illegible]yl-A[illegible]Rl, hat9ly, l. Ll69ha. y9AAt[illegible]2ly[illegible] A. ylyÁ[illegible]A11ACly[illegible]h1[illegible]ht un[illegible]ilh. RA. yli4[illegible]. [illegible]hh[illegible]h64[illegible]j 3 X””XVX”òí[illegible]

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[illegible]hLh8[illegible]A-Aaa8[illegible]r[illegible]2Ala8[illegible]RA[illegible] . hyC[illegible]h8[illegible], Ll C9l8[illegible] [illegible]Luf uAaf uA8[illegible]Aa6, . 8 R[illegible]. -[illegible](ííé[illegible]2[illegible] l[illegible] Ih[illegible]6A. ÍilC RA[illegible]huahy A , ial-Ay R a[illegible] A[illegible]haA3 u, Balh (ííéw lLAlalh aAihP [illegible] P At[illegible] i, A. ih RA[illegible]6A. ÍilC P[illegible] P [illegible]K((t[illegible]

[illegible]hu698[illegible]h[illegible], h. 8[illegible]u, yA48[illegible]y yAa8[illegible]4iAa8[illegible] r8 R[illegible]4. C9[illegible] Xjj([illegible]11ACly h1 RlAi[illegible] 4 C h[illegible] yAAR R yh4 [illegible]ACl i9l. l. 9l69P1ha 6A RlAiy h. C9h[illegible]AyiAah[illegible]Ch. iA. i R[illegible] i4 lR Ch, thylilh. h1 C[illegible] C[illegible] y lyyuAy h1 6ah5 l. 6 a, [illegible], Ly[illegible]. l, [illegible]C[illegible]í3[illegible]XX“)PXX“W[illegible]

[illegible] ARh8[illegible]lfuAla8 R[illegible] il. y8(ííí[illegible] u[illegible] lR[illegible] A RA C[illegible] C[illegible] RA ChaRAlahy haalAR[illegible] A tuahy A, AyilGhy Aa, l. hy A, t i 6A, A Ch. 1l. , A. ih[illegible]A2[illegible]a[illegible] hhiAC[illegible](j 3[illegible]X“(íPX“(ò[illegible]

[illegible](íí)[illegible]lLah[illegible] Ch RA [illegible]6alCunia 4 A[illegible] Aya ah[illegible]ua[illegible]h, h(3[illegible]. Bnlyly yACl hal[illegible] Ay8[illegible]A6u. R[illegible]t[illegible] iA3[illegible]uLyACl haAy [illegible] Aahy[illegible] dlu[illegible]XX8[illegible]2l. h4[illegible] al. h[illegible] AC[illegible]Ai[illegible] d[illegible] A. Aa[illegible] Í O lC[illegible] alR[illegible]

(íí"w uLRlaAOOlp. A. Aan RA yiR dyilOy 6ahnl, A. ial ly w . OuAyiy R Aay wAyuniR hy(íí"w R h2l. hwytw

(íí"w. ual lh RA yiR dyilO 6ahnl, A. ial lw AOaAial d A. Aan ÍO lO RAn l. lyiAalh RA 6alOuniuaB AyO 4 nl, A. iO lp. w uLRlaAOOlp. A. Aan RA yiR dyilOy 6ahnl, A. ialy wytw

(ííòwAO9hy4l1ay RAn 6alOuniuaB n AyO 4 nl, A. iO lp. A. ytw

(íXíw. ual lh RA yiR dyilO 6ahnl, A. ial lw AOaAial d A. Aan ÍO lO RAn l. lyiAalh RA 6alOuniuaB AyO 4 nl, A. iO lp. w uLRlaAOOlp. A. Aan RA yiR dyilOy 6ahnl, A. ialy wytw

w8w haLAa68 wAa68 R wARAayA. w(ííòwA. AilOta, AiAay1haOaOy yialiy R l. 2l2h, Ay uaAR, uyOnA R1 RAti9l. ly9A: An R9ahty9laA8 O 6alOwO. RwAOlh. V. l, n OA. OAw"òq(Á3éj P"é

AaOAa8wv8w ahi9Aayih. A8 wwaR 1lAnR8 R w u4wXjjéwyil, lh. h16A. AilO ta, AiAay1hauyA l. y9AAtylaAaA1AaA. OAyO9A, AywahOw"i9 nRwh. 6awA. Aiw ttnwl2Ayiwah RwXW3jVé(w

Aa. lAy8w8w O ARh8wlmh. A. oh8 R wAa. B. RA-w(ííòw RlOAy-hh, ÍialOhyA. u. , uAyia RAh2AsyOalhmy uau6u4 y waO9l2hy RAhhiAO. l8 "" qutwXÁ3éò)PéòWw

lnB. 8 w8w a. niA8 R ws w(íí)wOh. h, lOtah1li lni4 R4thmh64h1 lthmAy LaAARy9AAtla, yl. tl. w, n u, l. wAywéj3jòPXí"w

h. l. 8wXjjWwAOA. i, Ai9hRy1hataARlOl. 6fun li4h15 9hnA, A wahOé[i9]w w "" P""w

hail, Aa8w8w w2 RAa Aa18w w wOhL8w w Ai9lOo8 w wA aOA8 R w w a. Aaw (íXíwaAnl, l. a 4Ayil, Ayh16A. AilOta, AiAay1haOaOy y R, A fun li4 ialiyl. uyianl y9AAtw. l, wahRwOw"í3XX)"PXXééw

uTh- wwXjjòwn6 Rhh2l. h4Otal. hA. AnBaA RAn h, u. lRR uahtA 4A. An , u. Rhw wytw

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Ch, thylilh. □h1□Ca Cy□ y□ilyyuAy□h1□6ah5 l. 6□a,□ □□. R□A5 A□n;□ Lyw□□w□□. l, w□□Cl w□òí 3□ (òé" P□(ò"w□

□hilmh□□w□w□8□□ R□□w□□Aaa□ hw□Xj W'w□□ahRuCCl p. □□. l, m □4□□i. hmh6d□ □hhiÍ O. lCl□w□□Rw□□aiAy□ □aB1Cly□ □□haaAyw□□ R alRw□éí (□tw□

□□□□w□(íí (w□□Aaylh. □'W'w□□ACly18 □□uaAy. Ay8□□a□ CAw□□

□i□ 1haR8□□w8□□w□w□w□□I mA48□□w□w□ w□□h. Ay8□□ w□w□□alCA8□□. R□□w□w□□A, tw□(ííXw□□niay□ hu. R□ , Ay□ uaA, A. i□h1□mh. 6lyyl, uy□Rl, A. ylh. y□□ R□L□ o1□ □. □6ah5 l. 6□n;□ Ly3□□11ACly□h1□ 6 A8□5 Al69i□□. R□yA: w□□, m m□□u, l. w□□Ayw□é(3□XWj VXj "w□

□i□ 1haR8□□w8□□w□w□ w□□h. Ay8□□ R□□ w□w□□alCAw□Xj j Ww□□ Ai9hRy□h1□taARlCl l. 6□n;□ L□Ca Cy□ y□ Ch, thylilh. 3□□aA2lA5 w□□, □m□□u, l. w□□Ayw□(j 3□(éXV("éw□

□I□ i8□□w8□□w□□l, , 8□ R□□w□□ haalCm w□(íí"w□□CCua□□ 4□h1□uniay□ hu. R□, Ay□ uaAy□aAm□ l2A□ih□ C□aC□yy□, Ay□ uaAy□h1□LhR4□Ch, thylilh. □l. □y9AAtw□□w□□w□□A1 mAi□□(íé"8□□ Atw□□. l, w□ □Clw□□h5 □ □i□ A□□. l2w8□□, Ayw□□□w□

□□ u, 8□w□w8□□ w□w□□A□ m i8□□w□w□□A□□ mA48□□w□ w□□2 Am8□□ R□□w□w□□ □aaAii8□□w□w□□ lml;□ y8□□a□□ R□ □w□ w□□ lyAw□Xjj (w□□A2Amht, A. i□h1□n;□ L□Cly□ yl1lC□ lh. □□ R□tahRuCl lh. □y4yiA, y□ih□ 1□ lmi□iA□, □ oAil. 6□Ly□ AR□h. □Ca C□yy□Cui□LlmI i4w□□ 3□□9AAt□□AyAa C9□□l69m69iyw□ □Ata i, A. i□h1□□. l, m □□ClA. CAy8□□hmhaR h□□i□ A□□. l2Aayli4w□tt XP) X□(éí□tÁw

□Al: Ala8 □□w8□□w□□ □ hy8□□w□□hRal6uAy8□□w□□Am18 □□ R□□w□□R 2 A-w□(íí"w□□ □2l2h□Ayil, □ lh. □h1□ m□, L□Ca C□yy□Ch, thylilh. □L4□aAm Fll, A□uniay□ h. h6a□ 94w□□ A□ □□Clw□bé3□(Wj P(W'w□

□A, tmA8□□w□w8□□w□w□□ih. □ Aa8□□w□□h5 a48□□w□□hy□ h. 48□□. R□□ w□w□□□ AmAuyw□Xj ""w□□niay□ h. lC□ □ R□Ch. RuCl l2li4□, Ai9hRy□1ha□Ayil, □ l. 6□1□ □i9lCo. Ayy□l. □nl2A□C□ imAw□□ahCw□□ Ayiw□ □ACl w□□, w□□hCw□□. l, w□□ahRw□b3□éòòPéòòw□

□9AlmR8□ □w□Xj ""w□ □ttmlAR□□Ch. h, lC□□haACly□ il. 6w□□hai9P□hm□ R□□uLmly9l. 6□□h, t□ 48□ □, yiAaR,□ w□éòé□tw□

□9Íal□ m8□□ w8□□w□□h, a 8□□ R□□w□ w□□y ih. 6u□4w□(ííjw□□CCua□C4□h1□aAm □il, A□uniay□ hu. R□ , Ay□ uaA, A. iy□h1□hhim □ilyyuA8□1□ 8□□ R□, uyCmA□RAti9y□□i□Rl11AaA. i□, Ay□ ual. 6□yliAyw□ □w□. l, w□Clw□Wò3□XW'XPXVX)w□

haaA8 vXjjXv O iAadyilOy tahRuOl2y RA h2Asy RA a lthmAy A. tuaA- 4 A. Oau-, lA. ih Oh. , hauAOhy RA a Aal. h aAOh-4 nAlyO9yO91 1v Ayly hOlhan v . l2Aayli uiv. h, RA a OAnh. v

haaA8 v v s 8 v L aA6y 8 v v a , lh8 R v uO9v Xj Wj v O A lthmAy3 Aa1ha, OAy aAtahRuOl2Ay Ai RA OahIyy OA R . A : A. a O A tuaA Ai A. OahIyA, A. i 2AO RAy LÍnlAay Íal. hy aÍChOA Ai nAlyO9yO91 v 3 XXWj) v Í2n u lh. RAy h2l. y Ai RAy O al. y, ÍRliAaa ÍA. yv v n i Ai v v ha RP A9a q RlihayÁ ÍalA3 6alOuniuaAv h, , lyylh. RAy h, , u. i Íy AuahtÍA. Ay8 u: A, Lhua6v t é"íPé"Wv

haaAy8 v(ííòv a y ipOh. y O n y 4yu aAOutAaO lp. v A. iA. a lh RAn Aath Oh. n AiAal. a l8 yhO O lp. RAn uAath O lh. n AiAal. a lhw l. lyiAalh RA 6alOuniua8 R Aad 4 AyOv R alRv t v)))P)é)v

. nAOo8 v Xjòív lylRA. il1lO lh. R ylaA A2n u lh. v a4 Ov ")3X"jòPXòí(v

. nAOo8 v XjòíLv lylRA. il1lO lh. l. Ayil, l. 6 9A t Aa. n ylL ChaaAn lh. v a4 Ov ")3Xé"jPXéò"v

An Oh8 v8 v . AfuA8 v ÍaA-8 v -ualO8 v v d-8 R v ulRhLahv(ííXv ii4 OlR Oh, thylilh. h1 R lthyA RAthiy h1 yuOonl. 6 y Ly a lyAR u. RAa Rl11AaA. i tahRuOlh. y4yiA, yv A Ov j 3)("V)))v

. 68 v v v uinAR6A8 . R v l hn v Xjjév 4 Ayl n 4yly h1 , l: AR n. Aa , hRAny 2l lLLy y, tn. 6 5li9 tnlO lh. ih niiAa yl-A l. LAal tl6yv A. Aiv An 2hnv ("3 XPXX"v

AyiAn8 v v8 v v u 8 R v v nAOov Xj WWv A. AilO6ahuty l. . l, n , hRAnv v la4 Ov X3 X)XíPX)XWv

lAn R8 v8 v AlRAn8 v lA6 R8 R v aAuyAav Xj WíÁ Aau, nlthtahiAl. y R Chah. a4 RlyAy A q Á h, ta lyh. h1 9A lthtahiAl. tah1nA 5li9 9A aAyuniy h1 Chah. a4 . 6lh6a 94v i9AahyOnAahylyv "3 "jP(Wív

lR, Aa8 v v8 Xjj)v y lO tal. OltnAy h1 uniay hu. R l, 6l. 6v AiAal. a 4 l6 . hyilO niay hu. Rv uaRuA . l2Aayli48 Ayi 4 AiiA8 Rl 8 v

□ lmR8□□ww□Xj“íw□□9A□uyA□h1□unia□y h.lO□tuny Ay□1ha□9A□, Ay□ uaA, A.i□h1□LlhmI6lO□ □lyyyuAy□□ R□ i9A□RAiAOlh.□h1□lyyuA□RA.yli4□O9□ 6Ayw□□ua6Aa4□(ò3□XW)w□

□ lml□, y8□□ w□ w□(ííXw□□l2A□□.l, m□ □O□ O□y y□unia□y hu.R8□O□ □li□LA.A1li□4huJw□□ lyylyyltt l□□i□ A□ □.l2Aayli4w□t□(“)w□XP(w□

□ lml,□ y8□□ w□ w8□□w□ w□□Aaia□ R8□□w□ w□□ lml,□ y8□□ R□□w□ w□□A.4y9Aow□Xjjòw□□lOAty□1A, haly□□ R□ au, t□1□ □y □R Rlilh.m□ □unia□y hu.R□, Ay□ uaA, A.iy□1ha□JX□taARlOl.6□aAi□ m□t ahRuO□ □ R□al, , □ mA□1□i□.□LAA1□O□ O□y yAyw□□w□□.l, w□□Ow□ò“3□òVX)w□

□ lnyh.8□□ w□ w8□Xjj(w□□ttmO□ lh.□h1□unia□y hu.R□1ha□6A.AilO□l, tah2A, A.iw□□w□□.l, w□□Ow□òí3□ jò)PJ W)w□

□ lnyh.8□□ w□ w8□Xjjéw□□A□ P□l, A□unia□yh.lO□A2□ u□ lh.□h1□LAA1□O□ imAw□□h5□ □i□ A□□.l2Aayli4□ □A□ P□l, A□□nia□yhu.R□□aAOAail1lO□ lh.□□a□.l.6□□ah6a,□ w

□ lnyh.8□□ w□ w8□□ w□ w□ □huyA8□□ R□□w□ w□□ 4 yw□(íííw□□Rsuyi, A.i□1□O ihay□1ha□unia□y hu.R□ , Ay□ uaAy□l.□4A□ nl.6□□.6uy□Lumy□□ R□RA2Amhtl.6□9Al1Aayw□□, Ay3□□h5□ □i□ A□ □.l2Aayli4w□p□AA1□□AyA□ O9□□Athai□□w□ w□□A□ mAi□□XòXéÁw

□ h.68□□ w□ w8□□w□ w□□9A18□□w□ w□□ h.68□□ w□ w□□hylOo8□□w□ w□□h4nyih.□□ R□□w□ w□□9uni-w□Xjjòw□□11AOly□ h1□RlAi□ 4□Oh.su6□ AR□nl.hmAlO□□O lR□h.□n4, t9hO4iA□1u.Olh.□□ R□6ah5i9□h1□ , □, , □ 4□u, hay□l.□, lOAw□.ilO□ OAaw□□Ayw□Xò3j W)Pj j)w

□ hhR8□□w□ w□Xj Wéw□□□ □RAthylilh.□□ R□9A□fu□li4□h1□1□ □lyyuA□.□, A□ □□ l, m□ yw□.□□□iy□.□ □.l, m□□uialilh.w□□R□□w□□ lyA, □ w□□uiiAa5hai9y8□□h.Rh.w□t w□éíòPé)“w□□

□ hhR8□□w□ w8□□ R□□ w□□.yAaw□Xjjòw□□□Ohay□l.1nuA.Ol.6□1□ i4□O lRy□.□, A□ □□ R□9A□ahmA□h1□ □ ilh:lR□ iy□.□l, tah2l.6□, A□ □fu□li4w□□aw□□w□□uiaw□òW□p□uttm□XÁ3□“éj P“”íw□

□ hhR8□□w□ w8□□ w□□.yAa8□□w□ w□□ly9Aa8□□w□ w□□uiA8□□w□ w□□9A□ R8□□w□ w□□lO9□ Ryh.8□□w□ w□□u69Ay8□□ R□ □w□ w□□ 9liil.6ih.w□(ííWw□□□ □RAthylilh.8□1□ i4□O lR□Oh, thylilh.□□ R□, A□ □fu□li43□□□ aA2lA5w□□ A□ □□Ow□òW□)é)P)“Ww□□

□ hhR8□□w□ w8□□ w□□w□□lO9□ Ryh.8□□w□ w□□uiA8□□w□ w□□ly9Aa8□□ w□ w□□□, th8□□w□□y □ lRhu8□□w□ w□ □9A□ R8□□ R□□ w□□.yAaw□(íí)w□□11AOly□h1□1□ i4□O lRy□h.□, A□ □fu□li43□□ aA2lA5w□□ A□ □ □Ow□”3□(XV□)(w□

[illegible] haynA48[illegible] v[illegible]w8[illegible] v[illegible], li98[illegible] v[illegible] a . Aa8[illegible]. R[illegible] v[illegible]ihoAyv[illegible](í X(v[illegible] niay hu. R[illegible]a[illegible] yRuOAa[illegible]y9[illegible] A[illegible] 9[illegible]y[illegible] h[illegible]A11AOl[illegible]h. [illegible], Ay uaA, A. iy[illegible]h1[illegible]hu, La [illegible], uil1lRuy[illegible], uyOnA[illegible]yl-Av[illegible] [illegible] v[illegible]9Aav[illegible]Xò3[illegible] XWòPXj Xv[illegible]

[illegible]hu. 68[illegible] v[illegible]8[illegible] R[illegible]v[illegible] v[illegible] A[illegible] Aav[illegible]Xj j év[illegible] niay hu. R[illegible], Ay uaA, A. iy[illegible]taARlOl[illegible]Ayil, [illegible] AR[illegible]R ltthyA[illegible] [illegible] R[illegible], uyOnA[illegible]5 Al69iy[illegible]LAiiAa[illegible]i9[illegible] [illegible]Oa O[illegible]yy[illegible], Ay uaA, A. iyv[illegible]ahOv[illegible] v[illegible]v[illegible]hOv[illegible]. l, v[illegible] [illegible]ahRv[illegible]"é3[illegible](X"P(Xòv[illegible]

[illegible]hu. 68[illegible] v[illegible]8[illegible]. R[illegible] v[illegible]l, , v[illegible]Xj j í v[illegible] A. AilOl[illegible]ta [illegible] AiAay[illegible]1ha[illegible]l. [illegible]2l2h[illegible]LhR4[illegible], Ay uaA, A. iy[illegible]l. [illegible] [illegible]u11hno[illegible]y9AAtv[illegible]ahOAARv[illegible] A5 [illegible]An [illegible] R[illegible]hOv[illegible]. l, [illegible]n[illegible]ahRuOlh. v[illegible]"í 3[illegible]é í) Pé í " v[illegible]

[illegible]lt al. 8[illegible]v[illegible]w8[illegible]v[illegible]v[illegible]9AA8[illegible] R[illegible]v[illegible]v[illegible]2 lRyh. v[illegible]Xj j í v[illegible]9a [illegible] iAalyilOy[illegible]h1[illegible]thao[illegible]tahRuOly[illegible]1ah, [illegible] y5 l. A[illegible]1AR[illegible] 9l69[illegible], h. hu. y[illegible] ua[illegible] AR[illegible]1[illegible] [illegible]RlAiv[illegible]a i[illegible]) v[illegible]9l69P1[illegible]i[illegible]OuaAR[illegible]tahRuOlv[illegible] A[illegible] [illegible] [illegible]Olw(W3XòXPXW" w