Chemical Profiling of Testicular Parenchyma in Rams Using an Exploration of Echointensity Bands and a Novel Computer Algorithm (r-Algo) Increasing Specificity and Accuracy of Echotextural Analyses

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The main purpose of this study was to employ ultrasound image segmentation to increase the consistency and accuracy of determining chemical composition of rams' testicular parenchyma from its mean pixel intensity (image brightness). Ten testes obtained from sexually mature Karakul rams were scanned ex situ with an 8-MHz linear-array transducer, in the longitudinal and transverse plane, and all ultrasonograms were saved as digital images. The Kjeldahl method was used to determine the amount of crude protein, an oven-drying method was used to determine the moisture content, and a Soxhlet extraction of dried samples was used to determine the fat content of testicular tissue samples. Digital images of testicular parenchyma were normalized and subjected to computerized analysis using ImageProPlus® analytical software (bitmapping). Then two different approaches, namely echo intensity (EI) banding and algorithmic sequestration of resultants pixel intensity values (bitmaps), were compared for their usefulness in detecting quantitative correlations between numerical pixel values and proximate chemical composition of testicular tissue. Using 25- or 50-pixel intensity bands for testicular ultrasonograms obtained in the longitudinal (Long) and transverse (Trans) plane, we identified two Long EI bands (26-50 and 0-50) for which mean numerical pixel values (NPV) were significantly correlated with fat content, and four Trans EI bands with mean NPV significantly correlated with testicular tissue constituents (51-75, 76-100 and 51-100 with protein content, and 0-50, 51-75, and 51-100 with moisture). For Long images, the accuracy of predicting the fat, moisture and protein content of the testicular parenchyma using r-Algo–identified pixel intensity clusters was 87.43±2.50% (pixels 99-114), 99.54±0.11% (84-89), and 90.66±1.18% (49-55), respectively. For Trans images, the respective accuracy values were 86.37±1.49% (52-58), 99.34±0.13% (54-77), and 91.19±2.02% (50-67). Algorithmic detection of specific pixel intensity ranges appears to be an optimal method of pixel sequestration for determining precise correlations between first order echotextural characteristics (i.e., NPVs, pixel heterogeneity and frequency distribution) and chemical composition of the testes. Our present results highlight the importance of incorporating this method of computer-assisted image analysis for ultrasonographic monitoring of changes in testicular biochemistry/histophysiology.