

# Comparison of Ultrasonographic Images Retrieved using Two Different Probes (Mechanical Sector and Linear Ones) and Macroscopic Features of Bovine Reproductive Organs: Biometric Studies <sup>[1]</sup>

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<sup>[1]</sup> This paper was supported by the Grant in Aid from Polish National Sciences Center (DEC-2011/03/B/NZ9/01634)

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Article Code: KVFD-2016-16562 Received: 22.07.2016 Accepted: 07.02.2017 Published Online: 09.02.2017

## Citation of This Article

Piotrowska-Tomala KK, Jonczyk AW, Bah MM, Warmowski P, Skarzynski DJ: Comparison of ultrasonographic images retrieved using two different probes (mechanical sector and linear ones) and macroscopic features of bovine reproductive organs: Biometric studies. *Kafkas Univ Vet Fak Derg*, 23 (3): 487-490, 2017. DOI: 10.9775/kvfd.2016.16562

## Abstract

Objective of the study was to assess whether there are some differences in biometric measurements of the reproductive organs using mechanical sector or linear array ultrasound probe in comparison to the macroscopic measurements. The results revealed no significant differences between ultrasonographic (USG) images in comparison to macroscopic features. High correlations between post - mortem biometric measurements of examined structures and monitored via USG in conscious animals using both probes were found ( $P < 0.001$ ). In conclusion, both USG systems can be effectively used as clinical and research tools in the field of examination of bovine reproductive tract status.

**Keywords:** USG, Linear probe, Mechanical sector probe, Cow

# İki Farklı Prob (Mekanik Sektör ve Doğrusal Olanlar) Kullanarak Alınan Ultrasonografik Görüntülerin Karşılaştırılması ve Sığır Üreme Organlarının Makroskopik Özellikleri: Biyometrik Çalışmalar

## Özet

Bu çalışmanın amacı, ineklerde üreme organlarının mekanik sektör veya lineer ultrasonografi probu kullanılarak yapılan makroskopik biyometrik ölçümleri arasında bir farkın olup olmadığını karşılaştırmaktır. Çalışmadan elde edilen sonuçlar, makroskopik özellikler açısından ultrasonografik (USG) görüntüler arasında bir fark olmadığını göstermiştir. Post-mortem muayeneler ile canlı hayvanlarda yapılan muayeneler arasında, her iki USG probu ile incelenen yapılarda yüksek korelasyon bulundu ( $P < 0.001$ ). Sonuç olarak, ineklerde reproduktif organların klinik muayenesinde ve bilimsel araştırmalarında her iki USG sistemi de etkin bir şekilde kullanılabilir.

**Anahtar sözcükler:** USG, Lineer prob, Mekanik sektör prob, İnek

## INTRODUCTION

In veterinary practice, ultrasonography (USG) is the most profound technological advance to study changes in the ovarian morphology, including the characterization of bovine follicular waves and corpus luteum (CL) development during the estrous cycle and pregnancy <sup>[1]</sup>. The ultrasonographic examination is useful in the diagnosis of ovarian cysts and ovarian tumors in cattle <sup>[2]</sup>. Moreover,

in the area of pregnancy diagnosis <sup>[3,4]</sup>, fetal sex determination <sup>[4]</sup>, characteristic of reproductive system disorders in cows (endometritis, pyometra), transvaginal oocyte retrieval (ovum pick up) <sup>[5]</sup>, USG has proved to be particularly important technique <sup>[6,7]</sup>. Recent applications of USG in bovine reproduction includes color Doppler USG <sup>[8]</sup> and mammary gland USG <sup>[9]</sup>. Most ultrasound scanners routinely used in bovine reproduction are B-mode (brightness modality) real-time scanners, equipped with



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probes of varying frequencies. The commonly used frequencies in bovine reproduction are 3.5, 5.0 and 7.5 MHz, depending on the type of scanner [1]. The higher frequency probes create better USG images [6]. There are two types of probes used commonly in veterinary reproductive practice: linear (frequencies of 5-7.5 MHz) and the sector probe (frequencies of 3.5-7 MHz) [1]. The data comparing mechanical sector probe to the linear array probe are very limited [5,10].

In our study we assume that there are no differences between ultrasonographic features of bovine reproductive track structures and their macroscopic features. The purpose of present study was to compare biometric measurements of the reproductive organs using sector or linear probes against macroscopic measurements (post-mortem) in cows. The practical purpose of this study was to show the advantages or possible defects of both ultrasound scanners.

## MATERIAL and METHODS

### Animals

All animal procedures were approved by the Local Animal Care and Use Committee, University of Warmia and Mazury in Olsztyn, Poland (85/2012). This study was conducted in Pomerania, northern Poland during April 2014 to May 2015. Target population was consisted of Polish Holstein - Friesian cows (free of IBR/IPV, BVD/BM, EBL), which were under registration of the dairy herd improvement program, by Polish Federation of Cattle Breeders and Dairy Farmers. In the studied herd, the animals had non-seasonal reproductive programs and were bred routinely by artificial insemination. The farm had veterinary and nutrition consultants. Experimental cows (3 and more lactation) were culled from the farm because of the low milk production. The animals (n = 24) were housed in an intensive indoor barn system, milked twice a day and fed with a total mixed ration ad libitum to meet nutritional requirements of lactating cows (20-25 L per day), BCS (Body Condition Score) = 3.5.

### Experimental Procedures

*Comparison of ultrasonographic images retrieved using two different probes (mechanical sector and linear ones) and macroscopic features of bovine reproductive organs: biometric studies.* For transrectal USG examinations two types of probes Draminski Animal Profi Scanner (Draminski Electronics in Agriculture, Poland) were used: (i) mechanical sector (3.5/5.0/7.0 MHz; 180°) and (ii) linear probe (7.5 MHz). All examined structures were imaged before animals slaughter in local abattoir (Zakłady Mięsne "Warmia" Biskupiec). Then not later than 1-h after ultrasonographic examination the genitalia were collected from slaughtered cows and transported to the laboratory within 40 min after collection. Ovaries were cut with the knife and observed in cross-section. Measurements of separated uteri

were done in cross-section of the cranial tip of active uterine horn.

### Statistical analysis

Data were analyzed using correlations analyses (GraphPad Prism, version 5.00; GraphPad Software).  $P < 0.05$  was considered significant.

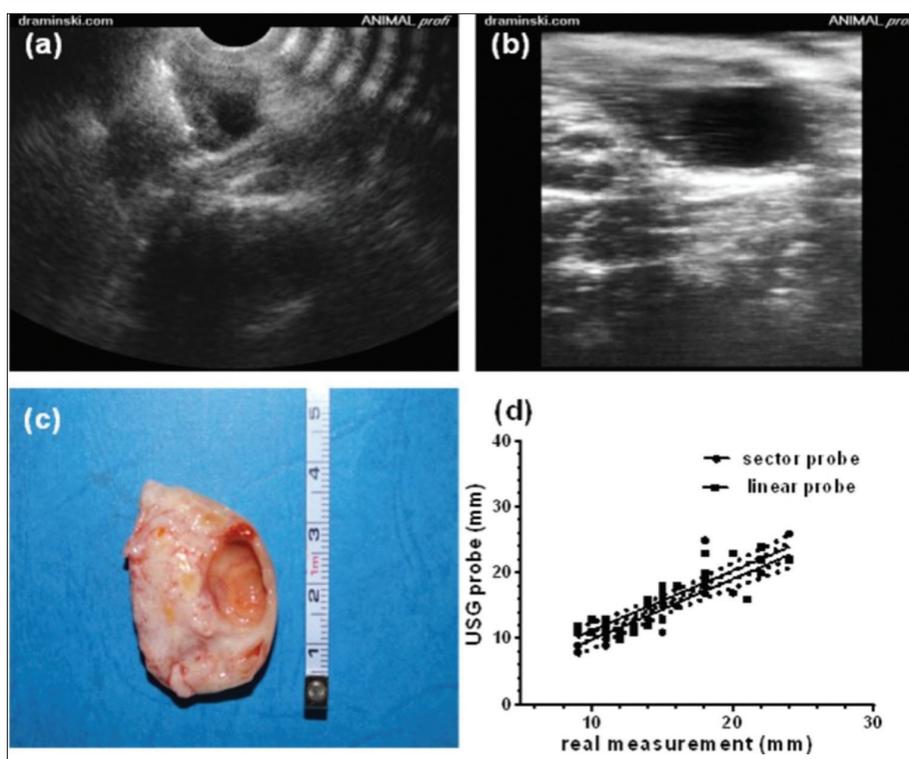
## RESULTS

In the experiment a representative USG images and macroscopic findings in a cross-section of the follicle, CL or uterine horn are present on *Fig. 1*, *Fig. 2* and *Fig. 3*. Corpora lutea (CL) were imaged in 16 ovaries, follicles (in various size) in 13 ovaries. Cysts were found in 6 ovaries, which were excluded for further correlation analyses. Uteri (n = 17) shown no pathological changes in their structures and were included for further correlation analyses. Additionally, we diagnosed endometritis (n = 5), pyometra (n = 1) and pregnancy (8-10 week; n = 1). These results were excluded for further correlation analyses. In respect to follicles (*Fig. 1*), high correlations between USG measurements of follicular diameter and assessed post-mortem were found ( $r = 0.88$  and  $r = 0.87$ , respectively;  $P < 0.001$ ). Similarly, we demonstrated correlations between USG and macroscopic measurements of the CL (*Fig. 2*) using sector or linear ultrasound probe compared to post-mortem findings ( $r = 0.94$  and  $r = 0.91$ , respectively;  $P < 0.001$ ). Moreover, we found correlations between post-mortem biometric measurements and ultrasonographic images of uteri (*Fig. 3*) using sector or linear ultrasound probes ( $r = 0.96$ ,  $r = 0.90$ ; respectively;  $P < 0.001$ ).

## DISCUSSION

Practical application of USG by veterinarians for reproductive organs examination is the most important method in livestock industry. Thus, the clarification of the ultrasonographic images is necessary to obtain a precision in the diagnosis of physiological and pathological ovarian structures and conditions of bovine uterus [11]. The USG examination of the ovaries and uterus in cows has been described in detail [11-13]. Moreover, previous studies have already compared the ultrasonographic features with macroscopic findings of examined structures [14]. However, in this study we compared ultrasonographic images obtained from both sector and linear probes. Therefore, practical purpose of our study was to show the advantages and similarity or possible defects of both probes.

In our experiment we found that the images of reproductive organs discernible by USG corresponded to their macroscopic features. Moreover, we determined the significant correlations between the size of examined structures measured by USG using both probes and related measurements assessed post-mortem. Similar results were



**Fig 1.** A representative ultrasonographic image and macroscopic finding in a cross-section of the follicle: (a) generated using a sector probe; (b) generated using a linear probe; (c) macroscopic finding of the follicle; (d) Correlation between diameter (mm) of the follicles evaluated using sector and linear probe in comparison to the real measurements (mm)

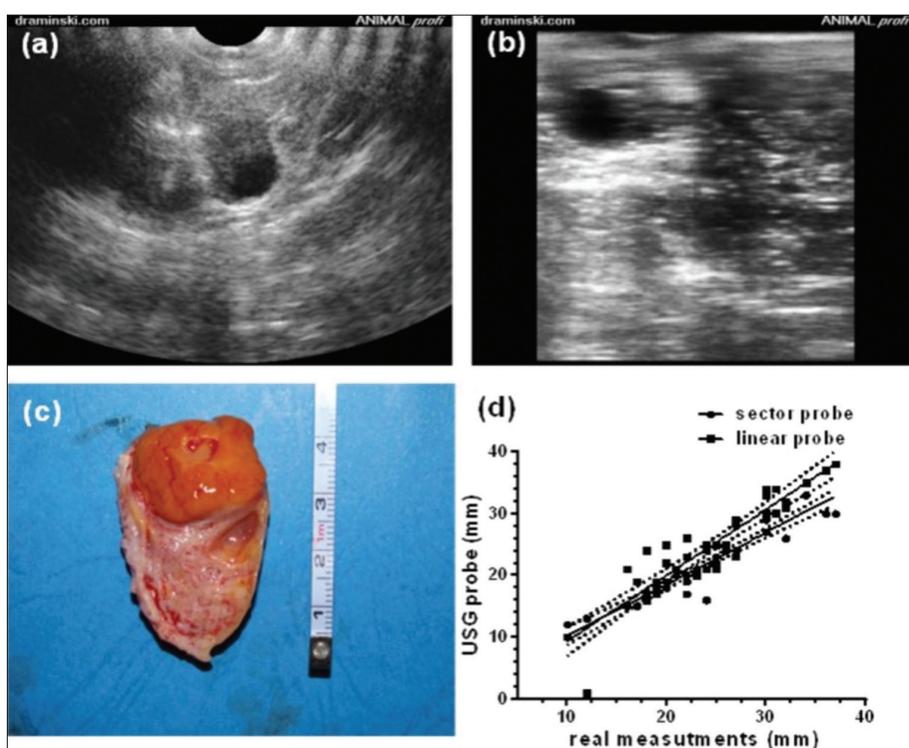
obtained by other authors who have found relationship between USG (using 5 MHz probe) and macroscopic measurements of follicles [13]. Moreover, Pierson and Ginther [13] have also reported high correlations between *in vivo* USG and post-mortem features of examined CL. In respect to the uteri similar findings were confirmed by Saito et al. [14].

In the practical purpose, both systems can be used for imaging of bovine reproductive organs. Our results showed that there were no differences between ultrasonographic features of reproductive organs achieved using both probes and their macroscopic features. Mechanical sector scanners offer multi-frequency capability, making them multi-functional and universal scanners. For early pregnancy diagnosis a 5 MHz or 7.5 MHz probe tends to provide more reliable results [3]. The linear probes using offer more detailed imaging of examined structures, which predisposes these probes for use in clinical trials (diagnosis of reproductive tract disorders). Moreover, Ribadu and Nakao [1] suggested that in routine bovine reproductive ultrasonography a 5 MHz linear rectal probe is the most effective.

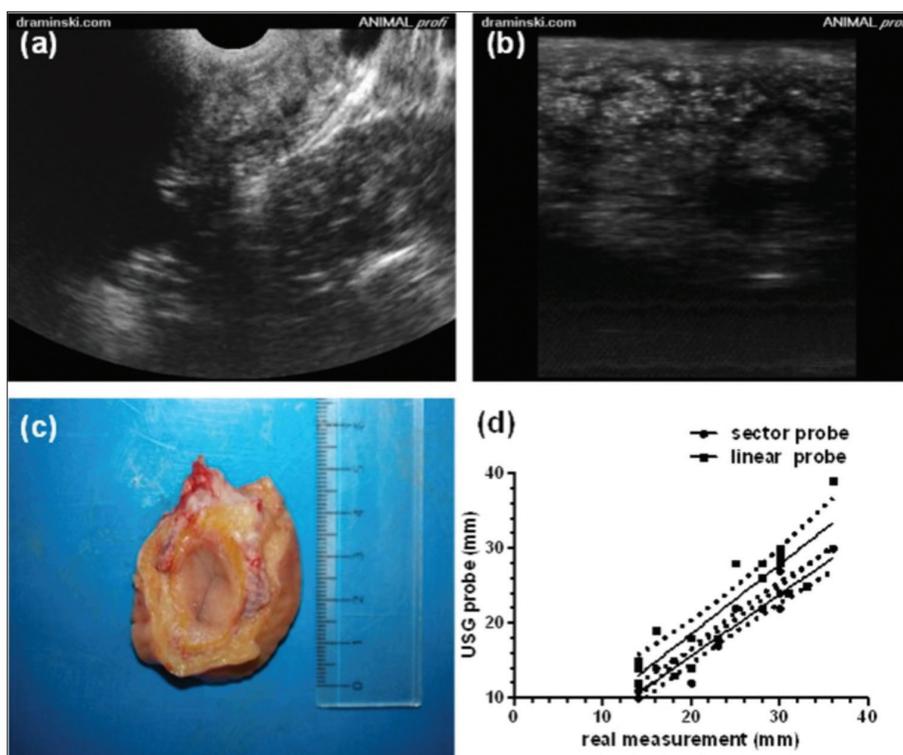
In conclusion, the results of our experiment revealed no significant differences between ultrasonographic images retrieved by both probes in comparison to macroscopic features. Moreover, high correlations between post-mortem biometric measurements of examined structures and monitored via USG in conscious animals using both probes were found.

#### ACKNOWLEDGMENTS

The article processing charge was covered by the grant of KNOW Consortium "Healthy Animal - Safe Food", MS&HE Decision No. 05-1/KNOW2/2015



**Fig 2.** A representative ultrasonographic image and macroscopic finding in a cross-section of the CL: (a) generated using a sector probe; (b) generated using linear probe; (c) Macroscopic finding of the CL; (d) Correlation between diameter (mm) of the CL evaluated using sector and linear probe in comparison to real measurements (mm)



**Fig 3.** A representative ultrasonographic image and macroscopic finding in a cross - section of uterine horn: (a) generated using a sector probe; (b) generated using a linear probe; (c) Macroscopic finding of uterine horn; (d) Correlation between diameter (mm) of uterine horn generated using sector and linear probe in comparison to real measurements (mm)

The authors thank Maciej Baurycza, director of the animal farm in Cieszymowo, Poland for his excellent cooperation and permission to use the animals for the experiments. We also want to thank Draminski Ultrasound Scanners (DRAMINSKI S.A., Owocowa-st 17, Olsztyn, POLAND) for their excellent cooperation, encouraging us in the work and providing USG apparatus for this study.

### CONFLICTS OF INTEREST

None of the authors have any conflicts of interest to declare.

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