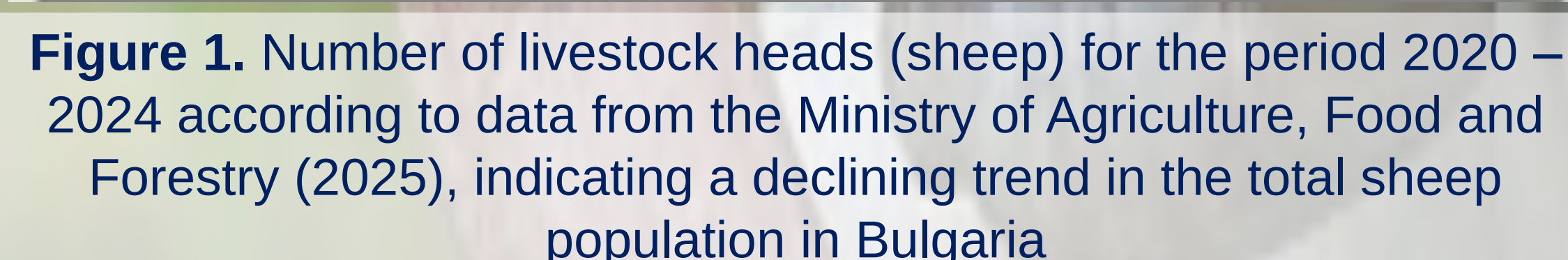


Krasimir Kotzev*, Desislava Abadjieva

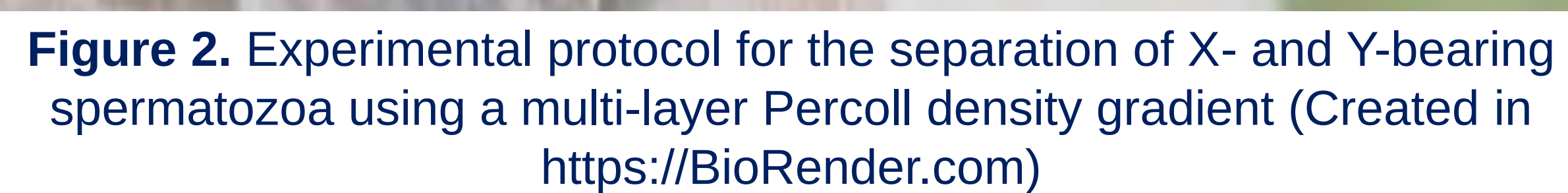
e-mail: krasimir.kotzev9@gmail.com

Sheep farming is an important agricultural sector in Bulgaria, yet recent statistics show a decline in the sheep population, raising concerns about the sustainability of production systems. Modern reproductive technologies are therefore needed to optimize reproduction and improve genetic progress (Ministry of Agriculture, Food and Forestry, 2025).



In sheep production systems, sperm sexing can support both meat-oriented production (male offspring) and dairy systems (female offspring).

Sperm sexing was performed using modified multilayer Percoll density gradient centrifugation method was applied (Yekti et al., 2024). Samples were divided into three groups: Control (untreated semen), RX – fraction enriched with X-bearing sperm, RY – fraction enriched with Y-bearing sperm. The process employed a five-layer gradient (20% to 60% density) arranged in descending order in Pyrex tubes. Separation was achieved by centrifugation at 2200 rpm for 5 minutes at 4°C, followed by washing of the isolated fractions. The resulting RX and RY fractions were subsequently re-analyzed using CASA to assess changes in sperm kinetics.



Kinematic parameters (VCL, VAP, VSL) also decreased after the Percoll separation process, indicating an effect of the technological procedure on sperm function.

Parameter	Control group (n=9)	RX group (n=9)	RY group (n=9)
Concentration (M/mL)	1582.73±182.39 ^a	314.79±33.67 ^b	219.81±74.12 ^b
Total motility (%)	97.70±1.24 ^a	50.22±9.85 ^b	47.11±11.40 ^b
Progressive motility (%)	36.09±4.68 ^a	4.71±0.50 ^c	12.54±2.47 ^b
VCL (μm/s)	62.63±4.41 ^a	28.64±2.76 ^b	32.37±6.31 ^b
VAP (μm/s)	32.13±2.47 ^a	13.71±2.25 ^b	15.28±4.14 ^b
VSL (μm/s)	17.31±1.23 ^a	9.55±3.07 ^b	13.87±5.40 ^b

Legend: Different superscript letters (a, b, c) within the same row indicate statistically significant differences ($P < 0.05$)

The use of sexed semen enables precise control of offspring sex ratio and improves the management of livestock production systems (Holden & Butler, 2018). In meat-oriented farms, the generation of male animals enhances growth performance, feed efficiency, and carcass yield, while in dairy systems the production of female offspring supports herd renewal and increases milk production potential (Prache et al., 2022). Additionally, improved reproductive management contributes to better animal health and reduces the need for veterinary treatments, lowering the risk of antibiotic residues in animal products and supporting food safety standards (Krupová et al., 2013).

In conclusion, the present study highlights the importance of semen quality and the application of sperm separation technologies as determinants of the future development of the sheep breeding sector. Integrating modern methods for semen evaluation and sexing in small ruminants is identified as a key factor for the sector's advancement. By enabling targeted management of population sex composition, it is possible to achieve not only economic efficiency but also predictable raw material quality, which is fundamental for ensuring safety throughout the entire food chain.

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