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Application of Gedis®Systems in Artificial Insemination Technology of Sows

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Abstract: *The Artificial Insemination Technology Is Widely Used In Swine(S.Domesticus) Breeding Herds As A Method Of Genetic Improvement Of Sows. There Are Currently Three Main Methods Of Inseminating Sows – Cervical, Post-Cervical And Deep Uterine Method. The Gedis® Catheter Is A Modification To The Traditional Catheter. The Aim Of This Study Was To Evaluate The Efficiency Of The Gedis® Catheter On The Reproductive Parameters Of Sows And Gilts, Depending On The Month Of Breeding, Parity And Weaning-To-Oestrus Interval. For This Study 565 Nrs. Gilts And 1714 Nrs. Multiparous Sows Were Inseminated During Timeframe Of 12 Months. Conception Rate, Farrowing Rate And Litter Size Parameters Were Evaluated. Overall Results Showed 90.60%-92.28% Conception Rate, 89.26%-91.40% Farrowing Rate, 12.93±3.23-14.05±3.75nrs.Total Born Piglets Per Litter And 12.44±3.23-13.21±3.59 Nrs. Live Born Piglets Per Litter. Month Of Breeding Has Significant Influence On The Reproductive Performance Of The Sows. Parity And Weaning-To-Oestrus Interval Does Not Have Influence On Conception Rate And Farrowing Rate Of The Animals. The Parity Of The Sows Has A Significant Influence On Litter Size. The Catheter Model Gedis® Can Be Used For Breeding Of Animals With Different Numbers Of Parities. The Gedis®Insemination Technology Has Shown To Yield Positive Fertility Performance Of Inseminated Sows While Easing The Insemination Process And The Handling Of Sperm Dose.*

Keywords *-Conception Rate, Gedis®, Farrowing Rate, Litter Size,Sows*

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I. Introduction

The Artificial Insemination Technology Is Widely Used In Swine Breeding Forgenetic Improvement Of Sows. There Are Currently Three Main Methods Of Inseminating Sows – Cervical (Conventional), Post-Cervical And Deep Uterine (1,2). The Cervical Method Is Used The Most Because Of Its Simple Application And Lower Costs. The Catheters Are Placed In The Middle Segment Of The Cervix To Prevent Back-Flow Of The Semen. An Individual Container (Bottle, Tube, Bag, Flat Pack) Of Semen Is Then Attached To The Catheter.

The Gedis® Catheter Is A Modification To The Traditional Catheter. This Model Of Catheter Is A Complete Insemination Unit With Extended Semen Packaged Along The Length Of The Catheter Shaft, In A Collapsible Membrane ("All–In–One"Design). The Results Of Previous Studies (3, 4, 5) Indicate That Inseminating Sows With A Gedis® Catheter Produces A Satisfactory Farrowing Rate (83.30-87.98%) And Total Number Of Piglets Born Per Litter (10.72-13.08 Nrs).

The Aim Of This Study Was To Evaluate The Efficiency Of The Gedis® Catheter On The Reproductive Parameters Of Sows And Gilts, Depending On The Month Of Breeding, Parity And Weaning-To-Oestrus Interval.

II. Materials And Methods

Animals

This Study Used A JSR Hybrid (565 Nrs. Gilts And 1 714 Nrs. Sows) That Were Housed On A Pig Farm In The Period Of January-December 2012. The Gilts At The Time Of Their First Service Were Approximately 176 Days Of Age And Weighed 110 To 118 Kg. The Young Animals Were Housed In Pens Of 4 To 5 Nrs. Gilts Per Pen. The Farrowing Sows Were Kept In Individual Farrowing Pens/Crates. The Lactation Period Was 26-29 Days. After Weaning, The Sows Were Kept In Gestation/Insemination Crates. The Animals

With Confirmed Pregnancy Were Housed In Group Pens (9 Nrs. Pregnancy Sows Per Pen). The Boars Were Housed In The Same Farm In Individual Pens.

Semen Collection Sperm Evaluation And Treatment

Semen Was Collected Not More Than Twice A Week From Boars Housed In The Same Farm By Using The Gloved Hand Method. Ejaculates Were Individually Assessed For Volume, Number Of Sperm Cells And Percent Of Motile Spermatozoa. Volume (Without Gel - Fraction) Was Determined By A Direct Reading From A Graduated Scale Of Glass Vessel With Precision Of 0.01 Ml. The Number Of Sperm Cells Was Determined By Using A Sperm-Density Meter (Modified KARRAS Staining Method (6). Percentage Of Motile Spermatozoa (0 To 100%) Was Evaluated Subjectively By Using A Standard Light Microscope At A Magnification Of 100X. The Minimum Standards For An Ejaculate To Be Acceptable For Use Were: Volume - >80 Ml; Color – Milky; Odor – Normal; Number Of Sperm Per Ml – 100 X 10^6; Motility - >70% And Agglutination - <30%. The Semen Was Diluted With Biodil Diluent (GENES DIFFUSION, France) In Rate 1+1 - 1+7 (V/V) With 2.5-3.0 X 10^9 Spermatozoa Per Dose And Packaged In Gedis® Catheters (IMV Technologies, France) By Manual Packaging System (Series 500) And Cooled Within 20 To 30 Minutes After Dilution. The Catheters With Diluted Semen Were Stored In Cooler Unit At 15-17° C Until Used Within 24 Hours After Collection.

Figure 1.GEDIS®Packagingmanual System, *Serie500*(Imvtechnologies, France)

Oestrusdetection.Artificial Insemination. Pregnancy Diagnosis

Starting From The 3rd Day After Weaning, Oestrus Detection Was Performed Twice A Day Between09:30 To 10:30 Am And 03:00 To 04:00 Pm By Moving The Mature Boar Down The Alley In Front Of The Animals While The Technician Conducted The Back-Pressure Test And Observed The Animals For External Signs Of Heat. The Occurrence Of Oestrus Was Defined By The Standing Reflex In Front Of A Teaser Boar And Reddening And Swelling Of The Vulva.

The Insemination Procedures Were Accomplished By Inserting The First 3/4 Of The Length Of The Catheter Into The Vagina And Then Pushed Firmly Forward Directly Into The Cervix. After Confirmation That The Catheter Was Locked Into The Cervix Rings, The Extension Was Removed. All Animals Were Inseminated Twice Per Oestrus. The Pregnancy Was Diagnosed 16 To 40 Days After Insemination By Mature Boars.

Figure 2. Artificial Insemination With A GEDIS® Catheter Model

Statistical Analysis

Prior To Data Analysis, The Animals Were Categorized Into Sets Depending On: 1) The Month Of Breeding; 2) Parity Of Sows (I, II, III, IV, V, VI, VII And VIII); And 3) Weaning-To-Oestrus Interval (Up To 3 Days, 4 Days, 5 Days, 6 Days, 7 Days And Over 7 Days). The Parameters Were Given As Follows: Conception Rate And Farrowing Rate (In Percentage) And Litter Size (Total Born And Live Born Piglets Per Litter). Then One-Way ANOVA With Fixed Effects Was Usedfor The Statistical Analysis. The Post Hoc Comparisons Were Done With LSD Test. All Calculations And Statistical Analyses Were Processed Using Statistical Package

Month	N	Conception Rate %	Farrowing Rate %	Total Born Piglets Nrs	Live-Born Piglets Nrs
January	57	89.47	87.72^{ab}	11.60±3.14^{abcdefghi}	11.37±2.97^{abcd}
February	27	88.89	88.89	13.16±2.79^{ai}	12.87±2.78
March	45	88.89	88.89	13.13±2.96^{bjklnt}	12.73±3.08^{E}
April	49	100^{ab}	100^{acd}	13.22±2.55^{cmnu}	12.51±2.57^{fh}
May	54	94.44	94.44	13.11±3.22^{dopqv}	12.43±3.50^{gi}
June	39	92.31	89.74	14.60±2.11^{ejondpry}	14.08±2.26^{abfgrs}
July	61	90.16	90.16	13.23±2.81^{fprsw}	12.65±2.66^{hijklmn}
August	40	92.50	92.50	11.69±3.70^{kmtuvwx}	11.47±3.58^{jk}
September	41	95.12	95.12	13.72±3.42^{gx}	13.29±3.16^{Co}
October	58	100^{cd}	98.28^{b}	13.03±3.64^{hy}	12.64±3.80^{dlop}
November	45	86.67^{ac}	86.67^{cd}	13.10±3.41^{i}	12.71±3.60^{mrs}
December	45	88.89^{bd}	84.44	11.76±3.71^{lnqs}	11.34±3.64^{enp}

Statistics For Windows Software, And Nonparametric Analysis Of Means And Proportion Using The *Student's* T-Criterion.

^{Abcdefghijklmnopqrst} values In The Same Columns With Different Superscript Are Significantly Different Between Groups (P<0.05).

III. Results

Table 1 Indicates The Reproductive Parameters Of Sows After Artificial Insemination With The Gedis® Catheter During The Different Months Of The Year. The Largest (P<0.05) Weaning-To-Oestrus Interval Occurred During August (4.95±1.26 Days) And September (4.86±1.24 Days). The Lowest (P<0.05) Weaning-To-Oestrus Interval Occurred During November (4.17±0.97 Days) And April (4.26±0.82 Days). Regarding The Conception Rate Of Animals, The Highest Rates Occurred During The Months Of March, April And May. Conception Rates Were Lower (P<0.05) During The Months Of December, January And February. The Same Tendency Was Observed In The Farrowing Rate Of Sows. The Number Of Total Piglets Born And Live-Born Piglets Was Highest (P<0.05) During May (14.77±3.18 Nrs. Total Born; 13.88±2.80 Nrs. Born Live) And June (15.10±3.01 Nrs. Total Born; 14.34±2.80 Nrs. Born Live). August Had The Lowest (P<0.05) Total Number Of Piglets Born Per Litter (12.91±4.09 Nrs.) And Live-Born Piglets Per Litters (11.73±4.20 Nrs).

The Reproductive Parameters Of The Gilts Shown In The Months After Artificial Insemination With Catheter Model Gedis®Are Presented In Table 2. Conception Rate Was Relatively High During Spring And Summer Months. Conception Rate Was Lower (P<0.05) In November (86.67%). The Same Statistical Dependence Was Found Also In Farrowing Rate. The Number Of Total Born Piglets And Live-Born Piglets Per Litter Were Less (P<0.05) In January, August And December.

Table2.Effect Of Breeding Month On Reproductive Parameters In Gilts After Artificial InseminationWith A Gedis® Catheter (Mean±SD),

Abcdefghijklmnopqrstuvwyvalues In The Same Columns With Different Superscript Are Significantly Different Between Groups (P<0.05)

The Effect Of Parity On Reproductive Performance Of Sows Artificially Inseminated With A Gedis® Catheter Is Indicated In Table 3. The Analysis Of Data Shows That The Most Extended Weaning-To-Oestrus Interval Occurred In 1st Parity Animals – 4.80±1.06 Days (P<0.05). Concerning The Conception Rate And Farrowing Rate The Values Are Similar Without Any Statistical Differences. There Is A Tendency Showing Lower Values In Sows On 1st And 7th Parity. The Fecundity Of Sows After Artificial Insemination Shows Lower (P<0.05) Values In Animals At 1st Parity And 7th Parity Respectively(13.12±3.74 Nrs. And 13.54±3.70 Nrs. Total Born Piglets, And 12.75±3.63 Nrs. And 10.70±4.19 Nrs. Live-Born Piglets Per Litter). Comparatively Low (P<0.05) Litter Size Is Obtained In Gilts – 12.93±3.23 Nrs. Total Born Piglets And 12.42±3.26 Nrs. Live-Born Piglets Per Litter.

Table3. Effect Of Parity On Reproductive Parameters In Sows After Artificial Insemination With Gedis® Catheter (Mean±SD).

parity	n	weaning-to-oestrus interval days	conception rate %	farrowing rate %	total born piglets nrs	Live-born piglets nrs
gilts	587	-	91.14	89.95	12.93±3.23^{abcdef}	12.42±3.26^{abcedf}
I parity	468	4.80±1.06^{abcdef}	88.89	88.46	13.12±3.74^{ghij}	12.75±3.63^{ghijkl}
II parity	342	4.47±0.89^{a}	90.35	90.35	14.21±3.69^{agh}	13.61±3.49^{agimnop}
III parity	197	4.48±0.92^{b}	92.39	91.37	14.49±4.07^{bik}	13.75±3.88^{bhjqw}
IV parity	143	4.48±0.91^{c}	93.71	91.61	15.81±3.59^{cjl}	14.02±3.55^{ckrstux}
V parity	157	4.43±0.73^{d}	91.08	90.45	14.88±3.61^{d}	13.08±3.11^{evw}
VI parity	128	4.56±0.76^{e}	93.75	92.45	13.65±3.83^{eklm}	12.50±3.55^{moqrtv}
VII parity	196	4.40±0.81^{f}	94.90	94.39	14.52±3.28^{f}	13.09±2.58^{dxy}
VIIIparity	38	4.55±0.66	86.84	86.84	13.54±3.70^{lm}	10.70±4.19^{flnpsuy}

^{Abcdefghijklmnopqrstuvwy}values In The Same Columns With Different Superscript Are Significantly Different Between Groups (P<0.05)

The Effect Of Weaning-To-Oestrus Interval On Reproductive Parameters In Sows After Artificial Insemination With A Gedis® Catheter Is Indicated In Table 4.It Was Found That Animals With Multiple Parities (4.16±2.27-4.80±1.06 Days) Show Earlier Oestrus Signs After Weaning, In Comparison With Sows With Less Parities (P<0.05). In The Present Study, Parity Did Not Have A Significant Influence On Conception Rate, Farrowing Rate Or Litter Size. Sows Inseminated On The 7th Day After Weaning Had A Larger (P<0.05) Number Of Live Born Piglets Per Litter Compared To Sows Inseminated On The 5th Day After Weaning (14.51±3.63 Nrs. Vs 13.09.±3.61 Nrs.).

Table4. Effect Of Weaning-To Oestrus Interval On Reproductive Parameters In Sows After Artificial Insemination With Gedis® Catheter (Mean±SD)

weaning-to-oestrus interval days	n	parity	conception rate %	farrowing rate %	total born piglets nrs	Live-born piglets nrs
up to 3day	43	4.16±2.27	97.72	97.72	14.41±3.40	13.90±3.30
4 day	791	4.84±4.14^{abcd}	95.45	94.56	14.13±3.67	13.20±3.54
5 day	584	4.71±2.21^{a}	95.20	94.69	13.94±3.78	13.09±3.61^{a}
6 day	100	3.90±2.39^{b}	94.00	93.00	13.90±3.72	13.22±3.42
7 day	31	3.41±2.16^{c}	93.55	93.00	15.13±3.52	14.51±3.63^{a}
over 7 day	48	3.62±2.03^{d}	93.75	93.75	13.48±5.10	13.04±4.80

^{abcd}values in the same columns with different superscript are different between groups (p<0.05)

IV. Discussion

Reproductive Parameters In Sows Depend On A Range Of Complex Endogenous And Exogenous Factors. The Present Study Revealed A Significant Influence Of Months/Seasons On Weaning-To-Oestrus Interval, Conception, Farrowing And Prolificacy. There Was An Extended Weaning-To-Oestrus Interval During The Warm Summer Months (June-July-August-September). The Same Tendencies Between Season And Duration Of Weaning-To-Oestrus Interval Have Been Found From Other Authors (7, 8, 9, 10) And It Was Connected To Detrimental Effects On Reproductive Parameters In Sows. Inseminating Sows During The Summer Months Commonly Decreases Farrowing Rate And Total Born Piglets In A Litter (11, 12, 13, 14, 15).

Our Results Regarding Conception And Prolificacy Are Different, Partly From These Tendenciesand The Lowest Values Of These Reproductive Parameters Have Been Obtained During The Winter Months In Gilts And Sows. Regarding Prolificacy, We Also Found Significantly Lower Values In Animals Inseminated In August. The Established Variations Concerning This Matter Are Probably Due To So Called *"Summer/Seasonal Infertility Syndrome"* In Pigs (16). This Phenomenon Is A Consequence Of High Ambient Temperature Levels And Prolonged Daily Photoperiod During The Warm Summer Months. The Combination Of These Factors Influences The Neuroendocrine Mechanism At The Level Of Central Nervous System-Hypothalamus-Pituitary-Ovaries (17).

Parity Is Another Important Factor Which Has Influence On The Reproductive Performance Of Sows. The Results Showed Clear Statistical Tendency That First Parity Animals Have Extended Weaning-To-Oestrus Interval – 4.80±1.06 Days (P<0.05) And Increased Number Of Parities Decreased During This Period. The Same Tendency Was Found By Cavalcantenetoet Al.(18) And Leite Et Al. (19). The Most Likely Reason That 1st Parity Sows Have An Extended Weaning-To-Oestrus Interval Is Due To Low Feed Intake During Lactation. Feed Intake In Primiparous Lactating Sows Is Generally Insufficient To Meet Nutrient Requirements For Milk Production And Body Growth. Thus, An Excessive Mobilization Of Body Reserves (Fat And Proteins) Occurs

To Meet Nutritional Demands By The Sow. Sows That Lost More Weight Have Extended Weaning-To-Oestrus Intervals And Extended Weaning-To-Ovulation Intervals. The Same Tendency (Without A Statistical Difference) Has Been Found Regarding Conception Rate And Farrowing Rate. Statistically Lower ($P<0.05$) Numbers Of Total Born And Live-Born Piglets Per Litter Were Found In The Animals At 1st Parity And The Reduction May Be Connected With"*Secondlitterdrop Syndrome*" (20).

The Variability Of Weaning-To-Oestrus Interval Is Negatively Associated With Reproductive Performance Of Sows. In The Current Study, It Was Found That Most Of The Sows (86.10%) Exhibit Oestrus Between $4^{th} – 5^{th}$ Day After Weaning, And 97% Of The Animals Show Oestrus Signs Up To 7^{th} Days After Weaning. Similar Results Were Observed By Vesseur (20), Belstra Et Al. (21), Behan And Watson, (22). There Is Non-Statistical Tendency For Conception Rate And Farrowing Rate To Decrease In Animals Bred Oestrus On The 6^{th} Day After Weaning.

The Use Of A Gedis®Catheter Could Be Referred As A Deep Cervical Method Of Semen Application In Sows. The Large, Soft, Pliable Tip Of The Catheter Gives Opportunity For Easy Moving In The Cervical Canal And Closely Locking In The Cervix. The Tip Of The Catheter Is Plugged With Heat Sensitive "Gel" And The Sow's Body Temperature Warms The "Gel" Plug After 8-10 Minutes; Thus, The Semen Dose Flows Gradually Into The Uterus (I.E. "Auto-Insemination"). With The Gedis® Technique The Insemination Time Is Significantly Decreased.

Research Has Found That After Inseminating Large Numbers Of Sows With A Traditional Cervical Catheter, There Can Be A Significant Reduction In Farrowing Rate And Litter Size Due To Fatigue Of The Breeding Technician (23). The Application Of The Gedis® Catheter Reduces The Time Required To Inseminate Sows, And Reduces Technician's Fatigue. In Addition, This Technique Allows The Technician To Simultaneously Inseminate Multiple Animals As After The Catheter Is Inserted In The Cervix, The Technician's Hands Are Free. Thus, The Technician Has More Freedom To Properly Stimulate Females And Supervise The Insemination Process.

The Results Showed That By Applyinggedis® Catheter In Sows With Different Parities, High Reproductive Performanceswere Achieved: Conception Rate – 90.60% In Sows And 92.28% In Gilts; Farrowing Rate – 89.26% In Sows And 91.40% In Gilts; Total Born Piglets Per Litter– 14.05±3.75 Nrs.In Sows And 12.93±3.23nrs. In Giltsand Live-Born Piglets Per Litter –13.21±3.59 Nrs.In Sows And 12.44±3.23 Nrs. In Gilts. Similar Results Were Found By Michalak (4) - 84.74% Farrowing Rate And 12.58 Nrs. Total Born Piglets In Litters With A Dose Of 2.5-3.0 X 10^9 Spermatozoa And Leyunizco (24) - 87.50-92.80% Conception Rate; 85.50-92.90% Farrowing Rate; 11.00-14.30 Nrs. Total Born Piglets And 13.50nrs. Live-Born Piglets Per Litter. Silva(5) Reported Comparatively Lower Results – 73.50% Farrowing Rate And 9.80 Nrs. Total Born Piglets In Litters.The Results Of The Present Study And Data Of Different Authors (5) Confirm That Use Of The Gedis® Catheterproduces Satisfactory Reproductive Performances Of Sows And Gilts. Some Of The Main Reasons For Using The Gedis® Catheter Are To Improve The Hygiene During Insemination, Prevent Back-Flow Of The Semen After Application And To Minimize The Effect Of The Technician's Qualifications.

V. Conclusion

Based On Results From Our Study, We Can Conclude That The Application Of The Deep Cervical Method For Artificial Insemination Of JSR Hybrid Gilts And Sows With A Gedis® Catheter, The Following Were Obtained:90.60% - 92.28% Conception Rate, 89.26% - 91.40% Farrowing Rate, 12.93±3.23 – 14.05±3.75 Nrs. Total Born Piglets Per Litter And 12.44±3.23 – 13.21±3.59 Nrs. Live-Born Piglets Per Litter. Month Of Breeding Has Significant Influence On The Reproductive Performance Of The Sows. Parity And Weaning-To-Oestrus Interval Does Not Have Influence On Conception Rate And Farrowing Rate Of The Animals. In The Present Study, Parity Did Not Have A Significant Influence On Conception Rate, Farrowing Rate Or Litter Size.The Catheter Model Gedis® Can Be Used For Breeding Of Animals With Different Numbers Of Parities.

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