

## PERUBAHAN KARAKTER EJAKULAT DAN AKTIVITAS ANTIOKSIDAN PADA MASA REPRODUKSI KAMBING KACANG DAN KAMBING PERANAKAN ETAWAH

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### RINGKASAN

Perubahan karakter ejakulat dan aktivitas antioksidan selama masa reproduksi, perlu dipertimbangkan dalam rangka penyediaan semen segar untuk Inseminasi Buatan pada kambing kacang dan kambing peranakan etawah.

Penelitian ini bertujuan mengungkap mekanisme perubahan karakter ejakulat melalui pendekatan aktivitas antioksidan pada masa reproduksi kambing kacang dan kambing peranakan etawah.

Serangkaian penelitian observasional analitik dan *cross sectional* dilakukan pada kambing kacang dan kambing peranakan etawah. Analisis data yang digunakan meliputi analisis varian satu arah (Uji F) untuk melihat perbedaan antara kambing umur muda, sedang dan tua, yang dilanjutkan dengan Uji BNT untuk mengetahui derajat beda. Uji t digunakan untuk melihat perbedaan antara kambing kacang dan kambing peranakan etawah. Sedangkan analisis regresi digunakan untuk menguji pengaruh aktivitas SOD terhadap integritas membran, pengaruh aktivitas katalase terhadap integritas membran serta pengaruh integritas membran terhadap motilitas, persentase hidup dan abnormalitas spermatozoa.

Sebanyak 60 ekor kambing jantan, sehat dan mempunyai libido tinggi digunakan sebagai hewan penelitian, yang terdiri dari 30 ekor kambing kacang dan 30 ekor kambing peranakan etawah, masing-masing terbagi dalam 10 ekor kambing umur muda, 10 ekor kambing umur sedang dan 10 ekor kambing umur tua. Selama masa adaptasi kambing penelitian diberikan pakan hijauan secara *ad libitum* dan konsentrat 0.5 kg/ekor/hari. Penampungan semen dilakukan dengan menggunakan vagina buatan setelah dirangsang libidonya dengan menghadirkan kambing betina birahi selama 1 jam. Semen segar hasil penampungan dilakukan pemeriksaan keadaan umum semen, yang meliputi warna, konsistensi, gerakan massa dan derajat keasaman. Jika semen menunjukkan gambaran keadaan umum normal, dilanjutkan dengan pemeriksaan karakter ejakulat dan aktivitas antioksidan. Karakter ejakulat yang diamati meliputi volume semen, konsentrasi, motilitas, persentase hidup, abnormalitas dan integritas membran spermatozoa. Aktivitas antioksidan yang diamati meliputi aktivitas SOD dan katalase.

Hasil penelitian menunjukkan bahwa terdapat perubahan karakter ejakulat dan aktivitas antioksidan pada masa reproduksi kambing kacang dan kambing peranakan etawah. Volume semen meningkat secara tidak nyata ( $P>0.05$ ) pada kambing kacang  $0.82\pm 0.10$  ml,  $0.83\pm 0.12$  ml,  $0.87\pm 0.12$  ml dan meningkat secara nyata ( $P<0.05$ ) pada kambing peranakan etawah  $0.95\pm 0.11$  ml,  $1.36\pm 0.12$  ml,  $1.43\pm 0.16$  ml. Konsentrasi spermatozoa menurun secara nyata

( $P < 0.05$ ) pada kambing kacang  $3.19 \pm 0.12 \times 10^9/\text{ml}$ ,  $2.99 \pm 0.11 \times 10^9/\text{ml}$ ,  $2.88 \pm 0.22 \times 10^9/\text{ml}$  dan menurun secara tidak nyata ( $P > 0.05$ ) pada kambing peranakan etawah  $3.43 \pm 0.20 \times 10^9/\text{ml}$ ,  $3.28 \pm 0.28 \times 10^9/\text{ml}$ ,  $3.27 \pm 0.20 \times 10^9/\text{ml}$ . Motilitas spermatozoa menurun secara nyata ( $P < 0.05$ ) pada kambing kacang  $92.23 \pm 0.77 \%$ ,  $90.64 \pm 0.64 \%$ ,  $90.31 \pm 0.79 \%$  dan pada kambing peranakan etawah  $92.12 \pm 1.06 \%$ ,  $91.43 \pm 0.78 \%$ ,  $90.71 \pm 0.54 \%$ . Persentase hidup spermatozoa menurun secara nyata ( $P < 0.05$ ) pada kambing kacang  $93.61 \pm 0.97 \%$ ,  $92.23 \pm 1.37 \%$ ,  $91.92 \pm 1.30 \%$  dan menurun secara tidak nyata ( $P > 0.05$ ) pada kambing peranakan etawah  $93.37 \pm 1.13 \%$ ,  $92.93 \pm 1.32 \%$ ,  $92.27 \pm 1.09 \%$ . Abnormalitas spermatozoa meningkat secara tidak nyata ( $P > 0.05$ ) pada kambing kacang  $1.95 \pm 0.89 \%$ ,  $2.45 \pm 1.13 \%$ ,  $2.80 \pm 1.23 \%$  dan pada kambing peranakan etawah  $1.89 \pm 1.08 \%$ ,  $2.57 \pm 0.91 \%$ ,  $2.89 \pm 0.90 \%$ . Integritas membran spermatozoa menurun secara nyata ( $P < 0.05$ ) pada kambing kacang  $88.38 \pm 0.92 \%$ ,  $85.66 \pm 0.86 \%$ ,  $84.35 \pm 0.72 \%$  dan pada kambing peranakan etawah  $88.13 \pm 1.25 \%$ ,  $87.53 \pm 0.98 \%$ ,  $86.14 \pm 1.01 \%$ . Aktivitas SOD total menurun secara nyata ( $P < 0.05$ ) pada kambing kacang  $8.96 \pm 0.20 \text{ U/ml}$ ,  $8.07 \pm 0.30 \text{ U/ml}$ ,  $7.25 \pm 0.49 \text{ U/ml}$  dan pada kambing peranakan etawah  $7.58 \pm 0.29 \text{ U/ml}$ ,  $6.98 \pm 0.37 \text{ U/ml}$ ,  $6.59 \pm 0.30 \text{ U/ml}$ . Aktivitas SOD spesifik menurun secara nyata ( $P < 0.05$ ) pada kambing kacang  $13.98 \pm 0.31 \text{ U/mg protein}$ ,  $12.57 \pm 0.47 \text{ U/mg protein}$ ,  $9.38 \pm 0.63 \text{ U/mg protein}$  dan pada kambing peranakan etawah  $12.07 \pm 0.46 \text{ U/mg protein}$ ,  $11.04 \pm 0.59 \text{ U/mg protein}$ ,  $8.46 \pm 0.39 \text{ U/mg protein}$ . Aktivitas katalase total menurun secara nyata ( $P < 0.05$ ) pada kambing kacang  $17.70 \pm 0.06 \text{ U/ml}$ ,  $17.64 \pm 0.05 \text{ U/ml}$ ,  $17.54 \pm 0.06 \text{ U/ml}$  dan pada kambing peranakan etawah  $17.88 \pm 0.06 \text{ U/ml}$ ,  $17.73 \pm 0.06 \text{ U/ml}$ ,  $17.67 \pm 0.06 \text{ U/ml}$ . Aktivitas katalase spesifik menurun secara nyata ( $P < 0.05$ ) pada kambing kacang  $27.61 \pm 0.09 \text{ U/mg protein}$ ,  $27.47 \pm 0.08 \text{ U/mg protein}$ ,  $22.49 \pm 0.08 \text{ U/mg protein}$  dan pada kambing peranakan etawah  $28.49 \pm 0.10 \text{ U/mg protein}$ ,  $28.05 \pm 0.09 \text{ U/mg protein}$ ,  $22.86 \pm 0.07 \text{ U/mg protein}$ .

Kambing kacang menghasilkan ejakulat dengan volume, konsentrasi, motilitas (kambing umur sedang), integritas membran spermatozoa (kambing umur sedang dan tua) and aktivitas katalase lebih rendah ( $P < 0.05$ ), tetapi aktivitas SOD lebih tinggi dibandingkan kambing peranakan etawah ( $P < 0.05$ ). Motilitas (kambing umur muda dan tua), persentase hidup, abnormalitas dan integritas membran spermatozoa (kambing umur muda) tidak berbeda nyata antara kambing kacang dan kambing peranakan ( $P > 0.05$ ).

Aktivitas SOD berpengaruh positif terhadap integritas membran spermatozoa ( $P < 0.05$ ,  $r^2_{kc} = 92.25\%$  &  $r^2_{pe} = 82.08\%$ ), demikian juga aktivitas katalase berpengaruh positif terhadap integritas membran spermatozoa ( $P < 0.05$ ,  $r^2_{kc} = 84.03\%$  &  $r^2_{pe} = 77.00\%$ ). Selanjutnya Integritas membran berpengaruh positif terhadap motilitas ( $P < 0.05$ ,  $r^2_{kc} = 89.55\%$  &  $r^2_{pe} = 90.83\%$ ) dan persentase hidup spermatozoa ( $P < 0.05$ ,  $r^2_{kc} = 65.41\%$  &  $r^2_{pe} = 86.70\%$ ), tetapi berpengaruh negatif terhadap abnormalitas spermatozoa ( $P < 0.05$ ,  $r^2_{kc} = 43.83\%$  &  $r^2_{pe} = 83.70\%$ ) pada masa reproduksi kambing kacang dan kambing peranakan etawah.

Berdasarkan hasil tersebut, diungkapkan bahwa aktivitas antioksidan mempunyai peran dalam mempertahankan integritas membran spermatozoa, yang memberikan pengaruh terhadap perubahan karakter ejakulat pada masa reproduksi kambing kacang dan kambing peranakan etawah.

Untuk mendapatkan semen segar yang mempunyai karakter ejakulat dan aktivitas antioksidan paling baik pada masa reproduksi kambing kacang dan kambing peranakan etawah, disarankan menggunakan kambing umur muda (kurang dari 1.5 tahun). Perlu dilakukan penelitian lebih lanjut dalam rangka meningkatkan produktivitas kambing umur tua, mempertahankan kualitas semen segar dan mengurangi penurunan kualitas spermatozoa pada semen beku melalui penambahan antioksidan.



## **EJACULATE CHARACTER AND ANTIOXIDANT ACTIVITY CHANGES IN SEMEN OF THE REPRODUCTIVE PERIOD OF KACANG AND PERANAKAN ETAWAH GOATS**

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### **SUMMARY**

The changes of ejaculate character and antioxidant activity during a reproductive period should be taken into account in the supply of fresh semen for artificial insemination in kacang and peranakan etawah goats.

This research examined the mechanism of changes in ejaculate character using an antioxidant activity approach during the reproductive period of kacang and peranakan etawah goats.

An analytic observational and cross sectional study have been conducted on kacang and peranakan etawah goats. Data analysis used in this study comprised one-way variance analysis to find the difference between young, middle, and old-aged goats, and followed with LSD test to determine the degree of difference. The use of t-test was aimed to identify the difference between kacang goat and peranakan etawah goat. Regression analysis was carried out to test the influence of SOD activity on membrane integrity, the influence of catalase activity on membrane integrity and the influence of membrane integrity on sperm motility, viability, and abnormality.

A number of 60 healthy male goats with high libido were used as experimental animals. They comprised 30 kacang goats and 30 peranakan etawah goats, each consisting of 10 young goats, 10 middle-aged, and 10 old-goats. During the adaptation period, those goats were fed ad libitum with concentrate of 0.5 kg/day for each goat. Semen was collected using artificial vagina after the libido was stimulated by presenting them with estrous female goat for 1 hour. Fresh semen obtained was examined for its general condition, comprising its color, consistence, mass motility and acidity. Normal results were followed with the examination of ejaculate characters and antioxidant activity. In this study, ejaculate characters to be observed were semen volume, concentration, motility, viability, abnormality and membrane integrity of sperms. The major antioxidant activities to be examined were SOD and catalase activities in semen.

The results showed that along with the increasing age there were changes in ejaculate characters and antioxidant activity of the reproductive period of kacang and peranakan etawah. Semen volume increased non-significantly ( $P>0.05$ ) in kacang goat of  $0.82\pm 0.10$  ml,  $0.83\pm 0.12$  ml,  $0.87\pm 0.12$  ml and increased significantly ( $P<0.05$ ) in peranakan etawah goat of  $0.95\pm 0.11$  ml,  $1.36\pm 0.12$  ml,  $1.43\pm 0.16$  ml. Sperm concentration decreased significantly ( $P<0.05$ ) in kacang goat of  $3.19\pm 0.12$  109/ml,  $2.99\pm 0.11$  109/ml,  $2.88\pm 0.22$  109/ml and decreased non-significantly ( $P>0.05$ ) in peranakan etawah goat of  $3.43\pm 0.20$  109/ml,  $3.28\pm 0.28$  109/ml,  $3.27\pm 0.20$  109/ml. Sperm motility

decreased significantly ( $P < 0.05$ ) in kacang goat of  $92.23 \pm 0.77$  %,  $90.64 \pm 0.64$  %,  $90.31 \pm 0.79$  % and in peranakan etawah goat of  $92.12 \pm 1.06$  %,  $91.43 \pm 0.78$  %,  $90.71 \pm 0.54$  %. Sperm viability was decreasing significantly ( $P < 0.05$ ) in kacang goat of  $93.61 \pm 0.97$  %,  $92.23 \pm 1.37$  %,  $91.92 \pm 1.30$  % and decreasing non-significantly ( $P > 0.05$ ) in peranakan etawah goat of  $93.37 \pm 1.13$  %,  $92.93 \pm 1.32$  %,  $92.27 \pm 1.09$  %. Sperm abnormality increased non-significantly ( $P > 0.05$ ) in kacang goat of  $1.95 \pm 0.89$  %,  $2.45 \pm 1.13$  %,  $2.80 \pm 1.23$  % and in peranakan etawah goat of  $1.89 \pm 1.08$  %,  $2.57 \pm 0.91$  %,  $2.89 \pm 0.90$  %. Sperm membrane integrity was decreasing significantly ( $P < 0.05$ ) in kacang goat of  $88.38 \pm 0.92$  %,  $85.66 \pm 0.86$  %,  $84.35 \pm 0.72$  % and in peranakan etawah goat of  $88.13 \pm 1.25$  %,  $87.53 \pm 0.98$  %,  $86.14 \pm 1.01$  %. Total SOD activity decreased significantly ( $P < 0.05$ ) in kacang goat of  $8.96 \pm 0.20$  U/ml,  $8.07 \pm 0.30$  U/ml,  $7.25 \pm 0.49$  U/ml and in peranakan etawah goat of  $7.58 \pm 0.29$  U/ml,  $6.98 \pm 0.37$  U/ml,  $6.59 \pm 0.30$  U/ml. Spesific SOD activity decreased significantly ( $P < 0.05$ ) in kacang goat of  $13.98 \pm 0.31$  U/mg protein,  $12.57 \pm 0.47$  U/mg protein,  $9.38 \pm 0.63$  U/mg protein and in peranakan etawah goat of  $12.07 \pm 0.46$  U/mg protein,  $11.04 \pm 0.59$  U/mg protein,  $8.46 \pm 0.39$  U/mg protein. Total catalase activity decreased significantly ( $P < 0.05$ ) in kacang goat of  $17.70 \pm 0.06$  U/ml,  $17.64 \pm 0.05$  U/ml,  $17.54 \pm 0.06$  U/ml and in peranakan etawah goat of  $17.88 \pm 0.06$  U/ml,  $17.73 \pm 0.06$  U/ml,  $17.67 \pm 0.06$  U/ml. Spesific catalase activity decreased significantly ( $P < 0.05$ ) in kacang goat of  $27.61 \pm 0.09$  U/mg protein,  $27.47 \pm 0.08$  U/mg protein,  $22.49 \pm 0.08$  U/mg protein and in peranakan etawah goat of  $28.49 \pm 0.10$  U/mg protein,  $28.05 \pm 0.09$  U/mg protein,  $22.86 \pm 0.07$  U/mg protein.

The kacang goat had significant lower level of semen volume, concentration, motility (middle age goat) and membrane integrity (middle and old age goats) of sperms, catalase activity than peranakan etawah goat ( $P < 0.05$ ). The kacang goat had significant higher level of SOD activity than peranakan etawah goat ( $P < 0.05$ ). However, the kacang and peranakan etawah goats had non-significant different level of motility (young and old age goats), viability, abnormality and membrane integrity (young age old) of sperms ( $P > 0.05$ ).

The regression analysis indicated that SOD activity influenced positively membrane integrity of sperm ( $P < 0.05$ ,  $r^2_{kc} = 92.25\%$  &  $r^2_{pe} = 82.08\%$ ), catalase activity influenced positively membrane integrity of sperm ( $P < 0.05$ ,  $r^2_{kc} = 84.03\%$  &  $r^2_{pe} = 77.00\%$ ), sperm membrane integrity influenced positively motility ( $P < 0.05$ ,  $r^2_{kc} = 89.55\%$  &  $r^2_{pe} = 90.83\%$ ) and viability of sperms ( $P < 0.05$ ,  $r^2_{kc} = 65.41\%$  &  $r^2_{pe} = 86.70\%$ ), but sperm membrane integrity influenced negatively abnormality of sperm ( $P < 0.05$ ,  $r^2_{kc} = 43.83\%$  &  $r^2_{pe} = 83.70\%$ ).

This study revealed that the antioxidant activity has influence in maintaining the integrity of sperm membrane, which affected the change of ejaculate character during reproductive period in kacang and peranakan etawah goats.

To obtain fresh semen that has the best ejaculate character and antioxidant activity during reproductive period in kacang and peranakan etawah goats, it is recommended to use young goats (aged less than 1.5 years). Further studies should be conducted to improve the productivity of aged goats, to maintain the quality of fresh semen and to decrease the reduction of sperm quality in frozen semen by the addition of antioxidant.

## ABSTRACT

### EJACULATE CHARACTER AND ANTIOXIDANT ACTIVITY CHANGES IN SEMEN OF THE REPRODUCTIVE PERIOD OF KACANG AND PERANAKAN ETAWAH GOATS

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The ejaculate character and antioxidant activity of semen from kacang and peranakan etawah goats were compared between the young, middle and old age of their reproductive period. In this study, semen volume, concentration, motility, viability, abnormality and membrane integrity of sperms, superoxide dismutase (SOD) and catalase activities in semen were examined in 60 male goats. Semen samples were obtained from kacang goat (n=30) and peranakan etawah goat (n=30) which were divided into three age groups.

The results showed that along with the increasing age there were changes in ejaculate characters and antioxidant activity of the reproductive period of kacang and peranakan etawah goats. Semen volume increased non-significantly ( $P>0.05$ ) in kacang goat and increased significantly ( $P<0.05$ ) in peranakan etawah goat. Sperm concentration decreased significantly ( $P<0.05$ ) in kacang goat and decreased non-significantly ( $P>0.05$ ) in peranakan etawah goat. Sperm viability decreased significantly ( $P<0.05$ ) in kacang goat and decreased non-significantly ( $P>0.05$ ) in peranakan etawah goat. Motility and membrane integrity of sperms decreased significantly ( $P<0.05$ ) in kacang and peranakan etawah goats. Sperm abnormality increased non-significantly ( $P>0.05$ ) in kacang and peranakan etawah goats. SOD and catalase activities decreased significantly ( $P<0.05$ ) in kacang and peranakan etawah goats. The regression analysis indicated that SOD activity had positive influence on membrane integrity of sperm ( $P<0.05$ ), catalase activity had positive influence on membrane integrity of sperm ( $P<0.05$ ), sperm membrane integrity had positive influence on motility and viability of sperms ( $P<0.05$ ), while sperm membrane integrity had negative influence on abnormality of sperm ( $P<0.05$ ).

It can be concluded that, the change of ejaculate character in old goats is influenced by a marked reduction within the semen of the major antioxidant enzymes system, superoxide dismutase and catalase.

**Keywords : ejaculate, superoxide dismutase, catalase, age, goats**