The Chromosomes of the Pig

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Introduction

Previous studies on the chromosome complex of the pig have been made by Wodsdalek (1913), Hance (1914) and Krallinger (1931). Wodsdalek reported 18 chromosomes in the spermatogonia and 20 in the ovary. He figured two X-chromosomes. His figures are not very clear and Hance suggested that they are due either to poorly fixed material or to tissue that was dead when preserved. Hance, in his studies, gave 40 as the diploid number. He based this conclusion on the results of a large number of counts and in addition, in the meiotic phase, he located 20 bivalents. Krallinger, from studies of spermatogonial plates, reported 38 as the chromosome number and in stages of meiosis gave 19 as the haploid number. Krallinger who is not prepared to doubt Hance's or his own findings, concluded that different breeds of pig may possess different numbers of chromosomes. He suggested that if the assumption were confirmed by subsequent investigations, then it could easily be explained by the origin of the domestic pig from the cross of *Sus scrofa* × *Sus vittatus*.

In this work a study has been made of the chromosome number in the Large White Yorkshire breed maintained at the Institute of Animal Genetics, Shothed Farm, Balerno. Testes have been taken from animals varying in age from 8 weeks to two years. Smears and sections were prepared, the former proving of little use for determining the chromosome complement.

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Material and Methods

The material was provided in testicular substance from pigs of the Large White breed. The testes were sectioned and placed in fixatives, 2BD, 2BE (La Cour 1931) 2BD and Carnoy, Medium Flemming and Strong Flemming. The material was embedded in wax and sections were cut from 10μ - 16μ and stained in the standard gentian violet stain.

Drawings were made with an H.I. 90, 1.30 apochromate oil immersion objective, at a magnification of 3500 diameters.

Observations

The sections prepared from the 8 weeks old animals produced actively dividing cells from which some counts were made for the somatic number. In these no stages of meiosis were found in such a condition to present any evidence of the haploid number. The sections prepared from material fixed in 2BD and Carnoy and Strong Flemming provided the clearest figures. At 10μ - 12μ it was found that several sections provided chromosome complexes with a varying number of chromosomes. Fig. 1. shows a complex cut at 10μ where 41 elements are seen. A number of these are small chromosomes and from further investigations it is suggested that some of the longer chromosomes have been cut through, a condition which would account for the varying number.

Figs. 1-3. Somatic chromosomes. 1, section cut at 10μ ; 2, section cut at 16μ ; 3, metaphase from a section cut at 16μ .

At 16μ several good plates were found showing the complete complex. Two of these are shown in Figs. 2 and 3. Each figure shows 38 chromosomes. The elements vary in size and shape, and types similar to those outlined by Krallinger can be seen. In each plate a chromosome, somewhat larger than any other is seen which

appears to bear no similar mate, and it is suggested that this is a sex chromosome. Arranging the series in pairs it is found that, supposing this long chromosome is a sex-chromosome, its mate is a small chromosome, a fact which would suggest that the pig possesses the XY type of sex elements. The number 38, has been decided upon after a comparison of the chromosomes in various plates but even then some doubt occurs whether or not some of the thicker elements are made up of two chromosomes clumped together. White (1932) has suggested that clumping may take place very quickly in some forms and if that is so, the time that elapses between killing the animal and fixation of the testes would be sufficient to account for the phenomenon. But, further, it is only in the sections cut at 10μ – 12μ that a greater chromosome number has been found.

Studies on the meiosis phases have produced further evidence suggesting, that in the animals studied, the diploid number is 38.

Fig. 4. Some diplotene associations—taken from cells at random. Fig. 5. Diakinesis stage. (a) Configurations from one cell. (b) Some bivalent forms.

In early prophase stages the elements are very distinct beaded threads, lying in a twisted state throughout the nucleus. The pair-

Figs. 6, 7, 8, 9. Some configurations taken from metaphase.

ing of threads throughout their entire length appears to be accompanied by a good deal of contraction. The threads at this stage are very distinct units and some degree of individuality is seen between

10

the paired units. A large horse shoe shaped pair is very evident in many of the cells observed.

11

12

Fig. 10. Some typical anaphase stages. Figs. 11, 12. Later stages in the separation of the components of the bivalents—see text.

In diplotene the bivalents adopt a contracted appearance accompanied by loops and nodes throughout their length. Fig. 4. The individual chromosomes of the bivalents here show great variation in size and the bivalents exhibit differences in the number of chiasmata formed.

In diakinesis Fig. 5 (a) and (b), bivalents were observed much contracted in appearance. No evidence was found relating to the association of the sex pair.

In metaphase Figs. 6, 7, 8 and 9, bivalents are found exhibiting configurations somewhat similar to those figured by Hance and Krallinger and counts made at this stage favour 19 as the haploid number.

Some anaphase configurations have been shown in Fig. 10.

Krallinger has stated that heteropycnosis of the sex chromosomes was not observed. In this study however, evidence was found pointing to some irregular behaviour of some chromosomes and two examples are shown in Figs. 11 and 12. Fig. 11 indicates the X and Y nature of the elements whereas in Fig. 12 only one element is seen.

Summary

1. The chromosome number of the pig—Large White Yorkshire—has been studied and evidence points to the diploid number being 38.
2. The meiotic stages have been studied and some observations have been made on the prophase, metaphase and anaphase stages.
3. It appears that the haploid number is 19 and that the sex chromosomes may exhibit irregular behaviour.
4. The evidence points to the sex-chromosomes being of the XY type.

References

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