Deer show a gender difference in the neural regulation of appetite by the brain

Brain chemicals called neuropeptides regulate seasonal changes in reproductive function and appetite. We took brains from red deer males and females at two contrasting seasons of the year and examined specific regions of the hypothalamus microscopically for the presence of cells containing regulatory neuropeptides. This was achieved by immunohistochemistry – i.e. use of highly specific antibodies to label cells – A, for presence of kisspeptin and gonadotropin inhibitory hormone (GnIH) which are neuropeptides involved respectively in the stimulation and inhibition of reproduction, and B, for presence of neuropeptide-Y (NPY) and gamma melanocyte stimulating hormone (MSH) which are involved respectively in stimulation and inhibition of appetite. Brains collected from males and females during the breeding season showed a large presence (200 to 600 versus 50 to 150 per region, breeding and non-breeding seasons respectively) of cells in the hypothalamus containing kisspeptin, which is consistent with the reproductive stimulatory role attributed to this peptide.

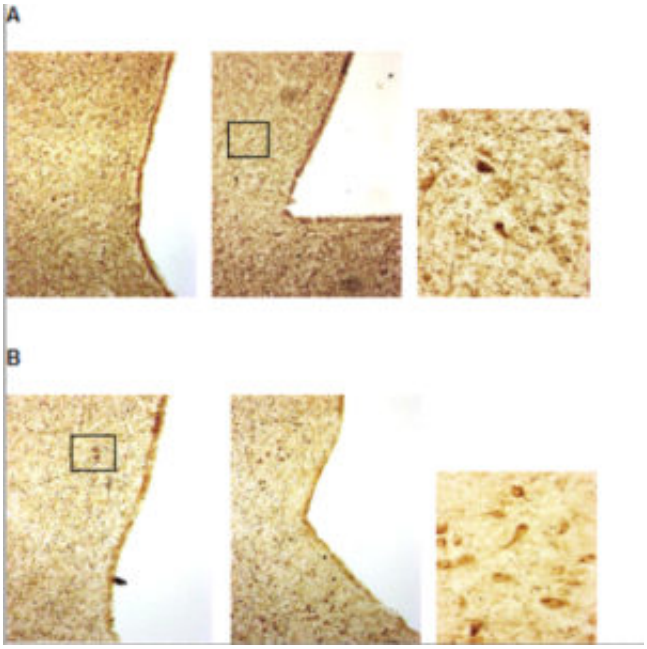

Fig. 1. Microscopic images of sections taken from the hypothalamic region of red deer brains that have been stained (brownish color) to show cells containing neuropeptide Y (NPY) - an appetite stimulating neuropeptide. The left-hand figures show examples from the non-breeding season, the middle figures show breeding season examples and the right-hand figures show magnified images of the boxed areas (in A and B the box has been placed on the section showing highest number of stained cells). A – females, i.e. hinds. B – males, i.e. stags. (It is evident that appetite-stimulatory regulation prevails during the non-breeding season in females and during the breeding season in males.)

The prevalence of GnIH-containing cells (about 250 per region) did not differ between seasons and this observation casts some doubt on the involvement of GnIH as an inhibitor of reproduction in this species. In the case of appetite-regulating peptides, female deer showed an increased presence of cells containing NPY during the non-breeding season (350 versus 150 per region, Figure 1) and the converse for MSH (500 versus 750 per region), which is what we would have predicted from prior knowledge about the respective appetite-stimulating and -inhibiting roles for these two peptides. Seasonally breeding animals such as deer show a marked reduction in feed intake (anorexia) during the breeding season and a resurgence of feeding once the mating period is over. It is thus surprising that brains from the male deer (stags) showed the opposite pattern for seasonal prevalence of the appetite-regulating peptides (300 versus 50 NPY cells per region and 300 versus 1000 MSH cells per region, for breeding and non-breeding seasons respectively) (Fig. 1). It is not known why the brains from these males do not conform with their female counterparts or with those of other species that have been examined in a similar manner. Red deer stags lose an extraordinary amount of body mass during the breeding season, for instance at this stage of the year these animals were losing 10 times more weight each day than the females in the study. It is possible that the seasonal changes in live weight of red deer stags are so large that they are obliged to make regulatory adjustments to brain signalling well ahead of when that has to occur in females and in other species where the weight changes are also less dramatic. Across all mammals, male deer display an extreme gender difference in terms of mature body size, which is almost double that of females, so it may not be too surprising that these males have what appears to be an aberrant mode of feed intake control in relation to their annual breeding pattern.

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