

Testing the 'parasite-mediated domestication' hypothesis: a comparative approach to the wild boar and domestic pig as model species

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Motivation and Aim: Many of the mechanisms behind the domestication/domestication syndrome have already been well explained. Starting with the pioneering studies on domestication by Dmitry Belyaev, who proposed that the domestication syndrome is genetically linked to genes associated with tameness. His experiment on domestication of silver foxes, which is among the most influential work in this field, showed that selection for tameness (impaired stress response, changes in the 'hypothalamic-pituitary-adrenal system' – HPA axis) leads to significant destabilisation of regulatory systems controlling morphological and behavioural development, resulting in changes that are otherwise characteristic of domestication syndrome [1]. Much later, some other findings were added. In the thyroid rhythm hypothesis, Crockford [2] proposed that domestication is also driven by genetically controlled changes in the activity rhythm of the thyroid gland, which have a crucial effect on heterochronic changes and thus play an important role in the domestication syndrome (e. g. paedomorphism). Furthermore, Wilkins et al. [3] proposed that the main phenotypic components of domestication syndrome are neural crest cells (NCC) derivatives, i. e. a result of a developmental reduction in NCC input for the affected phenotypic traits. Recently, the parasite-mediated domestication hypothesis (PMD) has been proposed [4]. Indeed, parasites literally affect all the major mechanisms that otherwise underlie the domestication syndrome (HPA, thyroid, NCC – e. g. neuroendocrine regulation, hormonal modulation, changes in the host miRNA profile, etc.). In addition, the characteristics of the domestication syndrome could be genetically linked to genes related to resistance/tolerance to parasites. Therefore, the PMD assumes an important role of endoparasites in the process of domestication, especially in the initial phase (proto-domestication). It predicts that the frequency of domestication syndrome traits in the wild population increases with decreasing genetic resistance to parasites and/or with

increasing parasite load. PMD can be tested in different ways, either experimentally (experimentally parasitised population) or comparatively (existing wild and domestic populations). Although comparative studies can be problematic for a variety of reasons, they are relatively easy to conduct and are therefore suitable for an initial test of hypothesised PMD baselines. It can be assumed that, under comparable conditions, the parasite load in the domestic population will be higher than in the wild population. Therefore, we tested the PMD here with a systematic comparative approach by analysing the parasite load in wild boar and free-ranging domestic pigs from a comparable environment.

Methods: Wild boar populations and free-ranging (grazing) domestic pig populations, one each from Slovenia (SLO) and Croatia (CRO), were included in the study. In both countries, the wild boar and domestic pig populations were located about 15 km apart, so they had similar chances of being exposed to the local parasitofauna. Domestic pigs were not threatened against parasites. Sampling of fresh faeces (from the rectum of hunted wild boar and immediately after defecation in domestic pig) was carried out between 3 November and 11 December 2023. A total of 59 individual faecal samples (SLO: 12 wild boar, 20 domestic pig; CRO: 14 wild boar, 13 domestic pig) were examined for endoparasites. The endoparasite load was analysed using faecal flotation and sedimentation diagnostics.

Results: A total of five different parasite taxa were found in the CRO samples. In terms of parasite load, there were no differences between the wild and domestic stratum, which were each infected with three different parasite taxa (wild boar: *Eimeria* sp., strongyle-type eggs, and *Strongyloides* spp.; domestic pig: *Cystoisospora suis*, strongyle-type eggs, and *Trichuris* sp.). There was no statistical difference between the strata in the strongyle-type eggs found in wild boar and domestic pig. A total of four different parasite taxa were found in SLO samples. Only two of them were found in wild boar (*Eimeria* sp., and *Oesophagostomum* sp.), but all four were found in domestic pig (*Eimeria* sp., *Balantidium coli*, *Oesophagostomum* sp., *Trichuris* sp.). For two matching parasites the load of *Oesophagostomum* sp. was significantly higher in domestic pig than in wild boar.

Conclusion: According to our preliminary results, there are indications in favour of PMD. However, we cannot draw a firm conclusion as there are many aspects that can mislead the interpretation. The first aspect concerns the possible artificial (either intentional or spontaneous) selection of resistant/tolerant animals aimed at increasing resistance [5] and possibly leading to a deceptively high resistance/tolerance to parasites in the domestic population, which was certainly not the case in our study. The second aspect, which may lead to the opposite, concerns relaxed selection, where the source of selection that was previously important for the maintenance of a particular trait is weakened or even eliminated [6]. Indeed, selection pressure from parasites may have been reduced during the domestication process, which, together with “stringent” artificial selection for desirable traits, could influence (jeopardise) the evolution of genetic resistance in (parasite-naïve) domestic animals [7, 8]. In pigs, however, it has been shown that domestication does not appear to act as a bottleneck limiting the diversity of parasite resistance genes [9]. Testing PMD based on parasite load/resistance/tolerance in existing populations of wild or domestic animals and simply comparing these populations is therefore interpretatively quite complex, although relatively easy to perform. Comparative studies, such as the present one, should be supported by a more focussed methodology. Either to examine the frequency of domestication syndrome traits in the wild population in relation to their parasite

resistance/load, or to examine the parasite resistance/load of wild animals showing signs of domestication syndrome (e. g. tameness) in comparison to completely wild animals of the same population. The other possibility would be an experimental approach, i. e. experimental proto-domestication, like the Belyaev fox experiment [1]. However, instead of selecting the animals for tameness, an experimental population of the wild counterpart of the domestic animals would be experimentally exposed to parasites, selected against parasite resistance, and analysed over generations for the frequency of domestication syndrome traits in the population. Besides, it must also be considered that the influence of parasites on the domestication process may not simply be generalised, as it is also possible that only certain parasites play a mediating role in the domestication process.

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