Queen longevity involves changes in expression of genes of multiple pathways in Temnothorax rugatulus

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Organisms vary tremendously in lifespan and in the number of offspring. In most animals, body maintenance is traded-off with reproduction, and the negative relationship between these traits is also apparent on the molecular level, though the mechanisms involved remain poorly understood. Senescence is manifested by an increase in oxidative stress and an accumulation of molecular damage with age. Apparently by-passing this trade-off, social insect queens are both extremely long-lived and highly fecund compared to workers. Indeed, ant queens of the genus Temnothorax can live for several decades and we study here changes in gene expression with queen age and fecundity to determine how the trade-off between those two traits is reshaped. We analysed tissue-specific gene expression in young founding queens and old highly fecund queens of the ant *Temnothorax rugatulus*. We found many more genes to be differentially expressed between the two age classes in the fat body compared to the brain. Surprisingly, though young and old queens strongly differed in ovary development, only few fecundity genes were differentially expressed. However, many longevity genes involved in well-known pathways or lifespan-associated biological processes changed their expression with age indicating that multiple longevity mechanisms are activated sequentially throughout a queens' life. Young queens rather invest in immunity (*i.e.* activation of the Toll signalling pathway) and resistance against severe environmental and physiological conditions associated with the founding phase (*i.e.* down regulation of the TOR pathway), while established older queens upregulate anti-aging processes (*i.e. up regulation of catalase, superoxide dismutase, heat shock 70 kDa proteins*). Finally, we identified a number of candidate genes and pathways, which are potentially involved in the reshaping of the fertility-longevity trade-off shedding light on how this is achieved on a proximate level.