Functional Analyses of Bitter Taste Receptors in Chickens

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出版情報：九州大学, 2017, 博士（農学）, 課程博士
バージョン：
権利関係：やむを得ない事由により本文ファイル非公開（3）

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Title: Functional Analyses of Bitter Taste Receptors in Chickens
(ニワトリの苦味受容体群の機能解析)
Category："Kou"

Thesis Summary

Taste perception is a crucial biological mechanism affecting food and water choices and consumption in the animal kingdom. Bitterness is usually believed to guard against toxicity, but some nutritious feedstuffs from plant contain bitter compounds that cause an aversive reaction without being poisonous at physiological concentrations. Bitter taste perception is mediated by a G-protein-coupled receptor (GPCR) family the type II receptors (*T2Rs*). The elucidation of the sense of taste in chicken offers opportunities to create and develop new feedstuffs for chickens and to contribute the understanding of the mammalian sense of taste. There are three putative chicken bitter taste receptors, *cT2R1*, *cT2R2*, and *cT2R7*, which were identified using genome information and cell-based assays. The previous report confirmed that *cT2R1* is the functional bitter taste receptor in chickens using behavioral experiment but the functionality of other two receptors has not yet been studied. Moreover, chicken bitter taste receptors were activated by a wider variety of bitter compounds but the receptor blocker is still unknown. Additionally, taste loss is a common phenomenon in older human population because both the number and functionality of taste buds reduce over the ages in human. However, there is no specific information on the relationship between aging and bitter taste perception in chickens. Thus, in this study, firstly I had focused on the sensitivities of the other two bitter taste receptors, *cT2R2* and *cT2R7*, by using their agonists in behavioral tests. Then, I cloned *cT2R7* from chicks palate tissue and constructed *cT2R1* and *cT2R7*-expressing cells for searching of new agonists and antagonists for these receptors. Later, I had investigated the aging effect on bitter taste sensitivity in chickens using behavioral experiments, real-time PCR and Western blotting analysis. The results of behavioral drinking tests in *cT2R2* and *cT2R7* agonists showed that *cT2R7* is one of the functional bitter taste receptor as same as *cT2R1* but *cT2R2* is not a functional bitter taste receptor in the chicken oral epithelium. By using both calcium imaging methods and behavioral tests, I found that 6-methoxyflavanone (6-meth) significantly inhibited the activity of both *cT2R1* and *cT2R7*, which is the first identified antagonist for chicken bitter taste receptors. Further, compound “X” was identified as the new agonist and the agonistic activity was inhibited by 6-meth for both *cT2R1* and *cT2R7*. The agonistic and antagonistic activities were compatible in both *in vitro* and *in vivo* levels. In the aging experiments, I had observed that the younger chicks showed higher behavioral aversions for bitter compounds than older birds. Additionally, younger chicks had higher relative mRNA and protein for *cT2R1* and *cT2R7* than older chickens, which indicated that younger chicks have higher sensitive to bitterness than older chickens. In summary, the above results suggested that *cT2R7* is a functional bitter taste receptor as same as *cT2R1*, but *cT2R2* is not and 6-meth is an antagonist and compound “X” is the new agonist for these two functional bitter taste receptors in chickens. Additionally, bitter taste sensitivity in chicken declines with growing age due to the reduction of *cT2Rs* expressions. Overall, these findings are very important information for clarifying the evaluation of bitter taste receptors in animals and will be useful for further research on the physiological functions of chickens bitter taste receptors.