Title: The Impact of Different Wort Boiling Temperatures on the Beer Foam Stabilizing Properties of Lipid Transfer Protein 1

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Beer consumers demand satisfactory and consistent foam stability thus it is a high priority for brewers. Beer foam is stabilized by the interaction between certain beer proteins, including lipid transfer protein 1 (LTP1), and isomerised hop -acids, but destabilized by lipids. In this study it was shown that the wort boiling temperature during the brewing process was critical in determining the final beer LTP1 content and conformation. LTP1 levels during brewing were measured by an LTP1 ELISA, using anti-native barley LTP1 polyclonal antibodies. It was observed that the higher wort boiling temperatures (˜102^{o}C), resulting from low altitude at sea level, reduced the final beer LTP1 level to 2-3g/ml, while the lower wort boiling temperatures (˜96^{o}C), resulting from higher altitudes (1800 m), produced level of LTP1 between 17-35 g/ml. Low levels of LTP1 in combination with elevated levels of free fatty acids (FFA) resulted in poor foam stability, while beer produced with low levels of LTP1 and FFA had satisfactory foam stability. Previous studies indicated the need for LTP1 denaturing to improve its foam stabilizing properties. However, the results presented here show that LTP1 denaturation reduces its ability to act as a binding protein for foam damaging FFA. These investigations suggest that wort boiling temperature is an important factor in determining the level and conformation of LTP1, thereby favouring satisfactory beer foam stability.