## ABSTRACT

Fish farming in Kenya is faced with the challenge of high cost of feeds because of the high cost of fish meal, an important protein ingredient incorporated into feeds. Thus, there is the urgent need for cheaper alternative protein sources that have similar or higher protein quality to partially or completely substitute fish meal in feeds. The effects of substituting fresh water shrimps meal (FWSM) with black soldier fly larvae meal (Hermetia illucens – BSFM) or adult cricket meal (Acheta domesticus – ACM) on physico-chemical and nutritional properties of hot-extruded fish feed pellets were investigated, prior to optimizing processing conditions of the extruder. The FWSM in a basic 30% protein fish feed formulation was substituted at 0% (control), 25%, 50% and 75% and moisture content of the formulation adjusted to 10%, 20% or 30%. Black soldier fly larvae meal was significantly ($P < 0.05$) higher than ACM and the FWSM on dry matter, fibre content and ether extract. Adult cricket meal was significantly ($P < 0.05$) higher than FWSM and BSFM on crude protein and in vitro protein digestibility. Optimization process gave optimum combination of extruder temperature, die diameter and feed pre-conditioning time of 120$^{o}$C, 2 mm and 100 s respectively. The addition of both insect-based meals did not show significant effect on the physico-chemical properties of the extrudates ($P < 0.05$). The level of substitution, however, significantly influenced floatability ($P < 0.001$), bulk density ($P < 0.001$) and water stability ($P < 0.01$). Moisture content of formulation also significantly affected ($P < 0.05$) all the studied physico-chemical properties apart from durability index ($P < 0.05$) and water absorption index ($P < 0.05$). Level of FWSM substitution did not significantly ($P < 0.05$) influence dry matter, crude protein and crude fibre content of formulations. The level of feed moisture content influenced ($P < 0.05$) dry matter, ash content, crude protein, ether extract and carbohydrate content but did not affect ($P < 0.05$) fibre content and in vitro protein digestibility. Increasing the level of FWSM substitution from 0% to 75% led to a significant ($P < 0.05$) increase in the levels of phosphorus and potassium while significantly ($P < 0.05$) reduced calcium and sodium levels. Extruded pellets containing 75% BSFM or 75% ACM had desirable physico-chemical and nutritional properties when feed moisture content was increased to 30%. The findings from this study inform fish feed manufacturers and fish farmers that they can substitute freshwater shrimps with either crickets or black soldier fly larvae meals in fish feed to achieve better physico-chemical and nutritional properties.