As part of the mating ritual, males of Drosophila species produce species-specific courtship song through wing vibrations. While previous studies have shown that indirect flight muscles (IFM), the major power producing muscles for flight, are neurally activated during song, the precise role of the flight musculature in courtship has not been investigated. Because flight is necessary for survival and some elements of the mating song are subject to sexual selection, this study aims to identify IFM contractile protein genes that may be subject to purifying and sexual selection. Here we examined lovesong characteristics of *Drosophila melanogaster* transgenic strains with mutations in the myosin regulatory light chain (DMLC2) known to affect myosin kinetics and IFM function. The interpulse interval (IPI), a song parameter important in mate recognition in *melanogaster* group, is not affected by any of the mutations tested. Compared to a control rescued null (D*mlc*2$^{+}$), a mutant with a truncated amino-terminal extension (D*mlc*2$^{\Delta 2\text{-}46}$) and a mutant with disrupted myosin light chain kinase phosphorylation sites (D*mlc*2$^{S66A,S67A}$) failed to produce normal sine song, but sings with much higher frequency. In contrast, a dual mutant (D*mlc*2$^{\Delta 2\text{-}46;S66A,S67A}$) produce normal sine song. During tethered flight D*mlc*2$^{S66A,S67A}$ produces a reduced wing beat frequency (158±3 Hz vs 202±3 Hz for D*mlc*2$^{+}$) while D*mlc*2$^{\Delta 2\text{-}46;S66A,S67A}$ produces no wing beat frequency. This differential manifestation during flight and song by DMLC2 mutations indicate distinct contractile mechanisms employed for two behaviors. Additionally, we show that mutations in thick-filament protein flightin have pleiotropic effects on flight and lovesong. In particular, null mutant *fln*$^{0}$ fails to produce wing beat or lovesong. Despite its essential role for flight, a region of flightin sequence is poorly conserved among drosophilids suggesting it is under positive selection. We propose that flightin fulfills dual role in enhancing power output for flight and influencing song parameters important for pre-mating isolation.