Cancer as global burden with increasing incidence is a second and among third cause of death in developed and developing economies respectively. Surgery, radiotherapy, chemotherapy, hormonal therapy and immunotherapy are the major management options. Thermal therapy is currently gaining attention as an alternative. Radiofrequency, laser, high intensity focused ultrasound, cryo and microwave ablations are forms of thermal ablation. Microwave ablation (MWA) exhibits faster heating of large targets, induction of higher temperatures within tissues, less susceptibility to perivascular heat sinks and short treatment duration makes it more suitable for the treatment of liver, lung, breast, renal and adrenal malignancies. Microwave antenna (applicator) is the most important part of MWA system. Many antennae such as dipole, monopole, single slot, dual slot, triaxial and choked have been designed mostly for liver ablation. These antennae have shortcomings especially high power reflection coefficient, low power dissipation and heat elongation on the antenna feedline (comet effect). In this research Dual Slot Antenna with a floating metallic sleeve was designed to create large ablation volume and spare adjacent tissues which are not directly involved in volume of interest. Aspect ratio, ablation diameter and ablation length of the antennae were determined from their applications on in vitro bovine liver, muscle, lung, heart, liver, lung and breast. Finite element method (FEM) was used to design and simulate the antenna geometry. It is also used to study microwave energy, necrosis, and temperature distributions in these tissues. The positions of the sleeve and the lengths were varied as well as the slot sizes to achieve optimally low reflection coefficient at operating frequency of 2.45 GHz. The best optimized design produced reflection coefficient of -25.2 dB, ablation length of 42.2 mm, ablation diameter 35.2 mm with aspect ratio of 0.83. Bovine liver, muscle, lung, heart and breast samples were ablated at different input powers and durations. Simulation results indicate greater reduction in reflection coefficient and backward heating with sleeved antenna than monopole, single slot and dual slot antennae in all the tissues. Ablation diameter and aspect ratio also increased with this new antenna. In vitro experimentation established that sleeved antenna is capable of localizing microwave energy in tissues than the existing antennae. There were no significant differences in the simulation and experimental results of the sleeved antenna. The study demonstrated that inclusion of floating metallic sleeve on dual slot antenna reduced backward heating along antenna shaft as well as increasing aspect ratio.