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Osseointegration of titanium implants modulated by vitamin K_2 and yerba mate extract in an animal model

Abstract

Bone defects are difficult to treat and represent challenges in clinical settings, including dental defects. This study aimed to evaluate the positive osseointegration impact of surface treatment of titanium implants by vitamin K2 (VK2) and yerba mate (*Ilex paraguariensis* A.St.-Hil.; Aquifoliales, Aquifoliaceae) extract (YME). To do so, we used 18 rabbits with day 1 inserted dental implants in their tibial bone. These 18 rabbits were subdivided into 3 groups; the control group received normal saline, the VK2 group received VK2, and the YME group received YME. For each group, three rabbits were sacrificed on day 30 of the experiment and the remaining three rabbits were sacrificed on day 45 following continuous interventional therapy. Implant insertion was confirmed by radiological analysis and osseointegration was confirmed by histological, proteomic, and genetic analysis. VK2 and YME have been associated with the production of tiny capillaries and collagen-rich membrane structures. The early ossification zones, which were rich in living osteoprogenitor cells and extremely dense in collagen fibre groups, were visible. YME and VK2 led to a nearly one-fold decline in bone MDA (nmol/L) levels in both experimental groups of animals compared to the control group (20.5 ± 0.6). VK2 or YME treatment showed up to a 20–40% rise in bone GSH-Px levels in contrast to the control group (25.8 ± 1.3). In comparison to the control group (20.1 ± 2.1), the treated groups (VK2 and YME) showed significantly higher TAS levels. The bone Runx2 fold change jumped considerably in all treated groups (VK2 and YME) in comparison to the control group (41.6 ± 2.1). The bone osteocalcin fold change jumped considerably in all treated groups (VK2 and YME) in contrast to the control group (11.7 ± 1.3). VK2 and YME facilitated osseointegration and improved bone regeneration together with reduced oxidative stress.