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#-----
# Zero replacement for the logratio method
# "martin" : Martín-Fernández et al.(2000, 2003)
# "fry" : Fry et al.(2000)
# "aitchison": Aitchison (1986, 2003)
#
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# Developed by Hiroyoshi Arai
#-----

zero.replace <- function(x, delta, total=100, method=c("martin", "fry", "aitchison"))

  if (any(x < 0)) {
    stop("Data contains negative value(s).")
  }

  if ((delta < 0) || (total <= 0)) {
    stop("Invalid delta and/or total.")
  }

  method <- match.arg(method)
  x[is.na(x)] <- 0
  x <- x/apply(x, 1, sum)*total
  z <- apply((x == 0), 1, sum)
  d <- ncol(x)

  if ((method == "martin") && !any(z*delta >= total)) {
    x <- (1-z*delta/total)*(x != 0)*x
    x[x == 0] <- delta
  } else {
    if ((method == "fry") && !any(z*delta*(z+1)*(d-z)/d^2 >= total)) {
      x <- (1-z*delta*(z+1)*(d-z)/d^2/total)*(x != 0)*x
      x <- x+delta*(z+1)*(d-z)/d^2*(x == 0)
    } else {
      if ((method == "aitchison") && !any((x-delta*(z+1)*z/d^2*(x != 0))[x != 0] <= 0))
        x <- x-delta*(z+1)*z/d^2*(x != 0)
      x <- x+delta*(z+1)*(d-z)/d^2*(x == 0)
    } else {
      stop("Invalid delta.")
    }
  }
}

return(x)
}

```