ABSTRACT

The role of lipids in health and disease in humans has been recognized for many decades and over the last fifteen years there has been an intense effort to develop suitable methodologies to discover, identify, and quantitatively monitor lipids in biological systems. That led to a dramatical increase on the use lipidomics in search of new possible biomarkers or to better understand pathological mechanisms. The cell membrane lipidomics is based on homeostatic balance of the fatty acid metabolic pathways and can give us important information on the composition activity and the cause of oxidative stress in the cellular membranes. Erythrocyte membrane lipidomic analysis offers some new perspectives in nutraceuticals and personalized health interventions in order to help therapies at molecular level, to maintain the best homeostasis possible in a pathological condition. Several studies have shown modification of the phospholipid content of cell membranes and point to alterations of the enzymic activity on the fatty acid metabolic pathways in diabetic patients.

Using a protocol widely tested in human profiling, in the present study erythrocyte membrane lipidome was examined in healthy and diseased dogs. In particular, a cluster composed of 10 cis fatty acids, present in membrane glycerophospholipids and representative of structural and functional properties of cell membrane, was chosen and quantitatively analyzed. This cluster consists of: 2 saturated fatty acids (SFA: palmitic and stearic acids); 3 monounsaturated fatty acids (MUFA, palmitoleic, oleic and cis-vaccenic acids); 3 polyunsaturated fatty acids omega-6 (PUFA, linoleic, dihomo-gamma linolenic, arachidonic acids); 2 polyunsaturated fatty acids omega-3 (PUFA, eicosapentaenoic and docosahexaenoic acids).

For the purpose of this study, blood samples were collected from 68 clinically healthy dogs, including 30 males (6 neutered) and 38 females (12 sterilized), weighting from 2.6 to 43 kg, aged from 2 to 156 months (median 41). The interval values and distribution for each fatty acid of the cluster were determined, providing the first panel describing the healthy dog lipidomic membrane profile. We used these interval values to evaluate correlations between FAME types, families and lipid indexes with the dog characteristics and the results showed an interesting correlation to bodyweight increase. More specific, with the increase of the bodyweight, an increase in palmitic acid and in the total levels of SFA, while a decrease of the omega-6 and the total PUFA was observed.

The same intervals when then used to evaluate diseased dogs:

ι) 49 dogs affected with chronic enteropathy (CE), consisting of 17 females (7 spayed) and 32 males (1 neutered), with a median age of 47 months (range 4–144). Interestingly, the CE dogs had higher values of palmitic acid and lower levels of stearic acid compared to healthy dogs, with an overall reduction of total SFA. In addition, the CE dogs showed reduced content of LA and increased DGLA when compared to healthy dogs.

ii) 12 dogs affected with diabetes mellitus (DM), consisting of 7 females (5 spayed) and 5 males (1 neutered), with a median age of 131 months (range 94–181). The results obtained showed increased levels of palmitoleic and oleic acids as well as the total MUFA content on DM dogs when compared to the healthy dogs. These fatty acids cannot derive from the enzymatic transformation of palmitic acid by the delta-9 desaturase and their increased levels indicate an accelerated Δ9 desaturase activity on the DM dogs. The activation of this enzymatic transformation is known to be related to the insulin response and the carbohydrate management, which is connected to lipid biosynthesis through the pyruvate and acetyl-CoA pathways.

In the current study, we provided the first panel of erythrocyte membrane fatty acids in healthy dogs choosing a cohort representative for the main structural and functional roles of these hydrophobic molecules in the cell membrane compartment. and demonstrated a first utility of the interval values established for healthy dogs to evaluate the condition of these two pathological conditions. The results obtained from this study indicate that the erythrocyte membrane lipidome of animal samples may be successfully applied in veterinary medicine and provide important of the cell membrane status in physiological and pathological conditions and a better understanding to how membranes are influenced by dietary habits.