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Detrimental effects of grape polyphenols Irrespective of a great deal of information claiming health-promoting properties of various polyphenols, it should be mentioned that not all flavonoids are necessarily beneficial, and their physiological effects depend on a range of factors including type, concentration, absorption and metabolic transformation, etc. Indeed, the dual role of this substance by producing either toxic or beneficial effects seems also to depend on doses and/or the experimental cell type (Hodek et al. 2002). It should be mentioned that in some of the aforementioned studies, the authors did not pay much attention to the detrimental consequences of grape extract feeding. In particular, decrease in chicken weight gain and increase in feed conversion ratio (FCR), while vitamin E supplementation improved FCR. Furthermore, inclusion of GPC into the chicken diet decreased fat digestibility, while vitamin E supplementation improved fat digestibility (Brenes et al. 2008). In other studies, it has been observed that condensed tannins could bind biliary salts, a limiting factor for efficient fat digestion in poultry (Krogdahl, 1985), with a concomitant reduction in their absorption and an increase in the faecal excretion in mice (Roy and Schneeman, 1981). Another mechanism whereby nutrients are rendered less digestible by polyphenols is through the inactivation of digestive enzymes. For example, proanthocyanidin extracts from bean greatly inhibited digestive enzymes (trypsin,  $\alpha$ -amylase and lipase) in young chicks (Longstaff and McNab, 1991). Moreno et al. (2003) also demonstrated in vitro the inhibitory effects of GSE on fat-metabolizing enzymes and lipoprotein lipase. There is some evidence to show that polyphenols can inhibit a range of enzymes including ?-

glucosidase and pancreatic lipase (You et al. 2011), $\beta$ -amylase and  $\beta$ -glucosidase activity (Yilmazer-Musa et al. 2012), alpha-amylase and alpha-glucosidase (McDougall et al.

2005). The inhibition of digestive enzymes may be explained with the ability of condensed tannins to form insoluble complexes with proteins in the gastrointestinal tract (Griffiths, 1986; Horigome et al. 1988).