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The effect of Aloe Vera Leaf Gel on Serum Total Antioxidant Capacity in New Born Calves

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Abstract

In this study the effect of Aloe vera leaf gel consumption with colostrum on the serum total antioxidant capacity of new born calves was investigated at 48h of age (time I) and 72h of age (time II). Thirteen Holstein calves with average of 45kg were divided into two groups randomly and 15 ml Aloe vera leaf gel with colostrum was given to treatment group daily. Blood specimen was collected from jugular vein at both times (I, II). Separated sera were used for determination of total antioxidant capacity. The mean values of serum total antioxidant capacity in control and treatment groups were respectively 338.2 mol/lit and 384.2 mol/lit at time I and 399 mol/lit and 504.4 mol/lit in control and treatment groups at time II. Results indicated that consumption of Aloe vera leaf gel as a natural compound with colostrum could increase serum total antioxidant capacity (TAC) and prevent new born calves from oxidative stress and consequence disease causing economical damages in farm.

Key words:

Aloe vera; Total antioxidant capacity; Colostrum; Calves

Abbreviation:

TAC: Total Antioxidant Capacity

Introduction

Oxidative stress occurs when free radicals defeat the antioxidant defensive mechanism of the body. In other word oxidative stress is defined as the disturbance of balance between free radicals and antioxidant defenses [1]. Free radicals are electrically unstable atoms or molecules which are able to remove electrons from other molecules in order to achieve stability [1]. Although oxygen is inherent to survival, high concentration of oxygen could produce dangerous substances such as free radicals [1]. Oxygen in its ground state contains two electrons in outer shell with the same spin. When one of the electrons changes its spin, the oxygen is transformed into a singlet state and becomes a powerful oxidant and undergoes reduction. Incomplete reduction of oxygen causes the formation of reactive oxygen species (ROS) that includes the hydroxyl radicals, the superoxide anion radicals and hydrogen peroxide [2]. Singlet oxygen can also react with nitric oxide (NO) to form peroxynitrite which is a powerful oxidant. The oxidant derived from NO often referred to as reactive nitrogen specious (RNS) [3,4]. The ROS are able to oxidize cellular component such as DNA, lipids and proteins [5]. The cell damages caused by free radicals lead to some diseases such as cancer, cardiovascular, immune dysfunction, diabetes and neurodegenerative disease [5,1]. Although the production of ROS are controlled, the low concentrations ROS are implicated in many cellular processes including

intracellular signaling for proliferation, apoptosis [6], modulation of immune response [7], mounting a defense response against pathogens [8]. Antioxidants are substances which present in low concentrations and delay or prevent the oxidation of proteins, DNA and lipids in cells. The antioxidant defense system consistent of many factors with exogenous or endogenous origin that function interactively and synergistically to neutralize free radicals [9]. These factors including glutathione (GSH) and other tissue thiols, heme proteins, coenzyme Q, bilirubin and urates and several antioxidant enzyemes such as superoxide dismutase (SOD), catalase (CAT), glutathion peroxidase (GPR) and glutathione-s-transferase (GST) [10,11,12,13]. Dietary antioxidants including vit E, vit C, beta carotene and other carotenoids and oxycarotenoids, lycopen and lutein, polyphenols e.g. flavonoids, flavones, flavonols and proanthocyanidins[9,14, 15].

Oxidative stress and its consequences is very important subject in new borns because they are susceptible to the negative effect of free radicals [16]. Pregnancy, parturition and postpartum are periods to accompany with oxidative stress due to alteration in steroid and prostaglandin metabolism in dam [17]. The change of intrauterine partial pressure oxygen relative to exterauterian environment and beginning of lung breathing expose new borns to oxidative stress because the antioxidant defense system in new born is relatively disproportionate to the high level of environmental oxygen [16]. Rising production of ROS play a key role in initiation and maintenance of conditions such as diarrhea or pneumonia [18,19,20]. Therefore new born calves are dependent on colostrum intake for the acquisition of immunoglobulins and other beneficial substances such as nutrients and antioxidants [21,22]. Colostrum with a significantly high total antioxidant capacity can be beneficial against the oxidative damages. It is rich in enzymatic antioxidant includes superoxide dismutase (SOD), glutathion peroxidase and catalase and non-enzymatic antioxidant such as vitamins E, A, C, lactoferrin, selenium, copper, zinc, cysteine, etc [23]. However, colostrum is rich in antioxidant, it is source of ROS due to high levels of macromolecules such as lipids and proteins that easily oxidize and also it has macrophages that use ROS generating system to destroy bacteria [24,25]. Since immunoglobulins are molecules with a high susceptibility to peroxidation [26], the observed negative correlation between immunoglobulin G (IgG) concenteration and antioxidant level in serum may be due to consumption of antioxidants for protection of colostrum immunoglobulins, furthermore it was shown redox balance of colostrum play a significant role in IgG absorption that may be due to protective effect of antioxidants on immunoglobulins [27]. Also in another research, adding selenium to colostrum resulted in the increase of immunoglobulin absorption in new born calves probably due to its antioxidant prorperty on protection of immunoglobulins [27,28].

Present study was performed for assessing the effect of Aloe vera leaf gel consumption with colostrum on the level of serum total antioxidant capacity in new born calves at 48 h of age (Time I) and 72 h of age (Time II). Aloe vera Aloe vera is a plant with a variety of components and many pharmacological activities [29]. It has high antioxidant activity that relates to its phenolic and flavonoid components [30,31,32]. Thirteen phenolic compounds from Aloe vera and Aloe arboreseas were identified and quantified [33]. Other components with antioxidant activity in Aloe vera exteracts are vit E, vit C and enzymatic activities of superoxide dismutase, catalase and glutathion peroxidase [29,34,35].

Materials and Methods

Materials

Aloe vera leaf gel obtained from Barig Essence Pharmaceutical Co. Other chemicals used for total antioxidant activity assay were purchased from Merk Darmstadt (Germany) and were of analytical grade.

Experimental animals

In this study thirteen Holeshtein calves with average of 45 kg were divided randomly into two groups of treatment and control. Treatment group were fed with 15 ml Aloe vera leaf gel with colostrum from birth to 72h of age on daily basis.

Specimen preparation

Blood specimens were taken from jugular vein before feeding with colostrum at 48h (time I) and 72 h (time II) of ages and then centrifuged at 3000 rpm for 10 minutes. Separated sera stored until analysis at- 20 C.

Total antioxidant capacity assay

The measurement of serum total antioxidant capacity (TAC) was done by the method described by Koracevic et al. (2001). The principle of this method is based on the inhibition of production of thiobarbituric acid reactive substances (TBARS) from sodium benzoate under the influence of the free oxygen radicals derived from fenton type reaction. This reaction can be measured specterophotometrically at 532 nm and the inhibition of color development is defined as the antioxidant activity [39].

Statistical analysis

The statistical analysis of data was based on mean values of serum total antioxidant capacity in examined groups. Mean values of control and treatment groups were compared using student's 't' test ($p \leq 0.05$). Data were analysed by SPSS 16 software.

Results

Mean value of serum total antioxidant capacity (TAC) did not differ significantly in control group at time I and Time II as shown in Table 1.

Table 1. Mean comparison of serum total antioxidant capacity (µ mole/lit) in control group at 48 of age (Time I) and 72 h of age (Time II).

Serum Total antioxidant capacity (µ mole/lit)					
	Mean value		Mean value	±SEM	P-value
Control group (Time I)	338	Control group (Time II)	399	44.9	ns
ns: not significant					

Mean value of serum total antioxidant capacity (TAC) did not differ significantly in control group at time I and Treatment Group at time I as shown in Table 2.

Table 2. Mean comparison of serum total antioxidant capacity (µ mole/lit) in control group at 48 of age (Time I) and treatment group at 48 h of age (Time I).

Serum Total antioxidant capacity(µ mole/lit)					
	Mean value		Mean value	±SEM	P-value
Control group (Time I)	338	Treatment group (Time I)	384.6	46	ns
ns: not significant					

Mean value of serum total antioxidant capacity (TAC) differed significantly ($P \leq 0.05$) in treatment group at time II compared with control group at time I as shown in Table 3.

Table 3. Mean comparison of serum total antioxidant capacity (µ mole/lit) in control group at 48 h of age (Time I) and treatment group at 72 h of age (Time II).

Serum Total antioxidant capacity(µ mole/lit)					
	Mean value		Mean value	±SEM	P-value
Control group (Time I)	338	Treatment group (Time II)	504.4	72.9	P ≤0.05

Discussion

The total antioxidant capacity of serum is not the sum of the activities of various antioxidant substances; rather, it is a dynamic equilibrium that is influenced by the interactions between each of the serum antioxidative constituents as cooperation of antioxidants provides greater protection against attacks by free radicals than any antioxidant alone. [36]. Determination of serum total antioxidant capacity (TAC) is not used for clinical diagnosis but it is used for scientific purposes, to examine the medical importance of free oxygen radicals and antioxidative defense [37, 38].

While several methods for serum total antioxidant activity determination have been developed but there is not reference value for it in human or animals [39,40]. Although TAC is frequently used for characterization of oxidative status of the body but it shows only non-enzymatic total antioxidant activities. Therefore antioxidant and antioxidant regenerating enzymes in blood cells and blood vessel walls which have high effect on the antioxidant properties of blood plasma is not reflected in the in vitro assay of isolated plasma [45]. Also various methods for TAC of plasma showed different values due to the use of different oxidant in TAC assay [45]. Non enzymatic antioxidant of plasma includes: Vitamin C, Glutathione α, Tocopherol, β-carotene, ubiqiunol-10, Albumin-SH, bilirubin [43, 44]. While bilirubin is the one of constituent non enzymatic plasma antioxidant, in this study all of new born calves were examined by veterinarian and were not seen jaundice or any problem. In this study the mean value of serum total antioxidant capacity (TAC) in control group at time II was 399 µmol/lit (Table 1), that was less than report of Moshfeghi and Zahiri, 2008[41]. The reason of difference may be due to applying different methods for serum total antioxidant assay or due to difference in nutritional and metabolic status and the kind of delivery of dam [40]. These conditions could be affected the level of serum total antioxidant capacity in dam and consequently in new born calves . Also mean value of serum total antioxidant capacity in control group at time I and II was respectively 338 µmol/lit and 399 µmol/lit that show 18% increase the level of serum total antioxidant capacity at time II compared with time I(table I). This result indicates increasing absorption of colostrum antioxidant within time in control group. In this study mean value of serum total antioxidant capacity in treatment group at time I was 384.6 µmol/lit table II that shows 13 % increase of serum total antioxidant capacity compered with control group at time I(table 2). Mean value of serum total antioxidant capacity in treatment group at time II was 504.4 µmol/lit (table 3) that show 49% increase compared with control group at time I ($P \leq 0.05$). These results could be due to the absorption of non-enzymatic antioxidant in Aloe vera gel such as phenols, flavonoids, vitamin C, Vitamin E. It has been proven; Aloe vera reduced malondialdehyde and increased the antioxidant capacity [48]. Also it was shown Aloe vera gel significantly increased plasma total antioxidant capacity (TAC) in healty volunteers [47]. Other reason for these results partly may be due to the effect of Aloe vera gel on permeability of entrocytic cells [30, 32] and consequently increase absorption of colostrum antioxidant in new born calves. In addition Shahraki Mojahed et al. (2016) showed plasma levels antioxidant enzyme Superoxide dismutase, Glutathione peroxidase and Catalase in normal rat after treatment with hydro alcoholic Aloe Vera gel were significantly increased and also restored level of these enzymes in starved rats [46]. Furthermore Acemannan a polysaccharide of Aloe vera leaf gel that increase the activity of enzymatic antioxidant such as Superoxide dismutase in oral ulcer animals [49].

Conclusion

In conclusion since the antioxidants are the factors that neutralize free radicals and prevent from oxidative stress under different pathological condition. We recommend the consumption of Aloe Vera leaf gel as a natural compound with colostrum could increase total antioxidant capacity and prevent new born calves from oxidative stress and consequence disease. On the other hand, previous study by Abuelo et al. (1913) was shown negative correlation between the level of serum antioxidants and the level of serum immunoglobulin in new born calves that was probably due to more consumption of colosterum antioxidants for protection of immunoglobulin's in colostrum. Another research showed Aloe vera leaf gel with colostrum decreased FPT (failure passive transfer) in new born calves [42]. Therefore Aloe vera gel consumption with colostrum not only could increase serum total antioxidant capacity but also increase the level of humeral immunity in new born calves. Finally Aloe vera leaf gel by these manners could have beneficial effect on the health of new born calves and consequently decrease economical damages in farm. Therefore in the next study for acquiring more significant result we recommend to increase the number of calves and the amount of using Aloe vera leaf gel in each experimental group. Also antioxidant enzymes such as Superoxide dismutase, Glutathione peroxidase and Catalase are necessary to be evaluated in further study.

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