

Study on Applying Artichoke Extract to Lessen The Toxicity of Aflatoxin to Chicken

Le Thi Ngoc Diep*

Department of Pharmacology and Toxicology, Faculty of Animal and Veterinary Science (FAVS)
Hanoi Agricultural University (HAU), Vietnam

ABSTRACT : The Artichoke extract at 10% was used to add in drinking water to understand its effect on Aflatoxicosis of chickens. The Artichoke extract at the dose of 6 ml per liter of drinking water was given (experiment group) or not (control group) and to Hybro chickens (150 birds), during the first 49 days of life. Also, the chickens were fed with foodstuff containing 200 ppb or 500 ppb Aflatoxin B₁. Results showed that, the chickens having Artichoke extract: (1) Had overcome the growth retardation caused by the toxin at concentration of 200 ppb and 500 ppb of Aflatoxin B₁ (an additional weight gain of about 200~400 g/bird). (2) The feed conversion was improved (a reduction of 200~400 g of feed per kg of bird living weight). (3) Aflatoxicosis lesions were mild in the chickens, which fed 500 ppb of Aflatoxin B₁ or not found in those having the toxin 200 ppb. The blood examinations at 28th and 49th days of the trial gave the following results: (1) The Artichoke extract had an effect of suppressing the changes of blood cell numbers, hemoglobin amount, packed cell volume, leukocyte formula that were caused by Aflatoxin B₁. (2) The Artichoke extract had an effect of suppressing the diminution of sugar, protein levels and the increase of the levels of GOT, GPT, alkaline phosphatase and bilirubin in the blood of intoxicated chickens. There was not or very few residue of Aflatoxin B₁ contained in the liver and muscle of chickens intoxicated by Aflatoxin B₁ having Artichoke, that was much lower than the allowed level in animal products.

Key Words : Artichoke, Aflatoxin B₁, Chicken, Effect

I. INTRODUCTION

Aflatoxin B₁ is produced by *Aspergillus flavus* and known as a hepatotoxin and also for its immunosuppressive effects (Smith and Hamilton, 1970; Huff *et al.*, 1986). The humid tropical conditions of Vietnam is favourable for outbreak of diseases, among which Aflatoxicosis is very dangerous that reduces productivity, causes serious losses in economy as well as affects people's health. To overcome these above-mentioned problems, there have been measures for preventing *Aspergillus flavus* and Aflatoxin, but in fact they have not been really effective.

Some of the results from our experiment have showed that Artichoke (*Cynara scolymus L.*) is a valuable pharmaceutical material with helpful active

substances by increasing the secretion of the bile and the diuretic as well as improving the function of detoxification of the liver. Artichoke is not harmful and has no effect on blood pressure, respiration of trial rabbits and on function of isolated heart of trial frogs. It is helpful in anti-histamin, especially in limiting the damage of liver caused by CCl₄ (carbotetrachloride) in white rats (Le Thi Ngoc Diep, 1999). The purpose of this study is to show the effects of Artichoke extract in preventing chickens from the toxicity of Aflatoxin B₁ to improve the productivity and quality of meat.

II. MATERIALS AND METHODS

A total of 150 one-day old chickens were divided into 5 groups. The first one is Control group, In the second and the third group chickens were fed with feed containing 200 ppb and 500 ppb Aflatoxin B₁, respectively. In the fourth and fifth group, chickens were fed as those in the second and the third group, but a 10% Artichoke extract at the dose of 6 ml per

*To whom correspondence should be addressed
List of abbreviations : A/G, Albmin/ Globulin; AOAC, Association of Official Analytical Chemists; DGKC, Deutsche Gesellschaft für Klinische Chemie; GOT, Glutamic-Oxaloacetic Transaminase; GPT, Glutamic-Pyruvic Transaminase; IARC, International Agency of Research on Cancer; IFCC, International Federation of Clinical Chemistry; MCV, Medium Cell Volume; PCV, Packed Cell Volume

liter was added to their drinking water.

The trial was being carried out for 49 days. All the groups of chickens were housed in the same room under the same condition of the microclimate. Feed and drinking water was provided *ad libitum* throughout the experiment. To determine the effect of Artichoke in lessening the toxicity caused by Aflatoxin B₁, the chickens were weighed weekly to determine the gains in body weight. Feed consumption was also defined everyday.

At the period of 28th and 49th day-old, we have collected 10 samples of blood from each group of chicken to determine the hematological parameters which reflect the nutrient situation of chickens, the function of immune organs and liver: the amount of erythrocytes, leukocytes, hemoglobin level, hematocrit, leukocyte formula were detected by the methods described by Schalm *et al.* (1975), level of glucose was examined by enzymatic colorimetric method of Trinder, GOT and GPT were found by the method described by Bergmeyer *et al.* (1986), alkaline phosphatase by optimized method conforming to the recommendation of the DGKC (Anon, 1972), bilirubin by colorimetric method (Jendrassik *et al.*, 1986), total plasma protein by colorimetric method (Weichselbaum, 1946) and protein fraction by method of electrophoresis on acetate cellulose).

At the end of the experiment an autopsy of 10 chickens from each group was done to monitor the gross and histopathological changes in some organs such as liver, cholecyst, bursa of fabricius, kidney, spleen, thymus and muscle and also to define the residue of Aflatoxin in the liver and muscle of the chickens by the method of AOAC and IARC.

Aflatoxin B₁ was provided by the Department of Veterinary Hygiene, National Institute Veterinary Research. Artichoke extract was provided by the Department of Technique, Pharmacy Factory of Lam Dong, Da Lat.

III. RESULTS

1. Effect of Artichoke on growth rate of chickens intoxicated by Aflatoxin B₁

The result was showed on Table 1.

At the period of 49 day-old, the average body weight of Aflatoxin B₁ intoxicated chickens was 84.6% (group 2) and 73.3% (group 3) against those in the control group. The chickens fed with Aflatoxin B₁ and drank Artichoke added water grow normally. At the period of 7, 28 and 49 day-old the average body weights of chickens were 96.6%, 98.7% and 99.1% (group 4); 96.6%, 98.0% and 96.8% (group 5), respectively in comparison with the control group. At the end of the experiment, the growth rate of chickens in group 4 and group 5 were 11.1% and 32.1% that higher than those in group 2 and group 3. It is clear that the weight of chickens fed by Aflatoxin B₁ is significantly reduced, the weight of chickens intoxicated by Aflatoxin B₁ and drinking water added Artichoke extract increased similar to that of the control chickens. So that Artichoke extract could be used to lessen the toxicity and weight losing in Aflatoxin B₁ intoxicated chickens.

2. Effect of Artichoke on the feed conversion rate of chickens intoxicated by Aflatoxin B₁

The result on Table 2 showed that, at the dose of

Table 1. Effect of Artichoke on growth rate of chickens intoxicated by Aflatoxin B₁

Age of chicks	The average body weight of trial chickens (g)										
	Group 1 Control 0 ppb Aflatoxin B ₁		Group 2 200 ppb Aflatoxin B ₁			Group 3 500 ppb Aflatoxin B ₁		Group 4 200 ppb Aflatoxin B ₁ + Artichoke		Group 5 500 ppb Aflatoxin B ₁ + Artichoke	
	$\bar{X} \pm m_x$	$\bar{X} \pm m_x$	P	$\bar{X} \pm m_x$	P	$\bar{X} \pm m_x$	P	$\bar{X} \pm m_x$	P	$\bar{X} \pm m_x$	P
1	44.20±1.56	44.00±1.46		43.90±1.43		43.90±1.20		43.60±0.77			
7	148.70±3.76	139.30±8.70	>0.05	140.00±6.70	>0.05	143.80±7.50	>0.05	143.60±13.16	>0.05		
14	328.40±12.14	299.30±40.70	<0.05	305.00±50.00	<0.05	321.25±30.25	>0.05	320.60±20.00	>0.05		
21	604.30±31.30	553.30±60.60	<0.05	548.50±100.83	<0.05	596.25±45.80	>0.05	585.40±56.40	>0.05		
28	1030.00±50.20	848.30±98.26	<0.05	842.00±119.42	<0.01	1018.00±48.90	>0.05	1009.00±84.80	>0.05		
35	1420.00±52.60	1190.00±93.00	<0.01	1118.20±158.20	<0.01	1396.00±60.46	>0.05	1361.00±94.50	>0.05		
42	1750.00±55.60	1470.00±67.00	<0.01	1285.00±162.00	<0.01	1700.00±60.46	>0.05	1685.00±97.00	>0.05		
49	2105.00±50.60	1781.00±70.26	<0.01	1542.00±165.00	<0.01	2086.00±90.00	>0.05	2037.00±107.50	>0.05		

Table 2. Effect of Artichoke on feed conversion rate of chickens intoxicated by Aflatoxin B₁

Trial groups of chickens	Feed conversion rate (kg feed/1 kgP)	%
1 : 0 ppb Aflatoxin B ₁	1.77	100.0
2 : 200 ppb Aflatoxin B ₁	1.93	109.0
3 : 500 ppb Aflatoxin B ₁	2.18	123.0
4 : 200 ppb Aflatoxin B ₁ + Artichoke	1.75	98.9
5 : 500 ppb Aflatoxin B ₁ + Artichoke	1.78	100.5

200 ppb and 500 ppb Aflatoxin B₁, an increase of the feed conversion rate of chickens in group 2 and group 3 (intoxicated birds), a decrease of that one in group 4 and no change in group 5 (intoxicated birds having Artichoke) were observed in comparison with the result in the control group.

3. Effect of Artichoke on hematological parameters of chickens intoxicated by Aflatoxin B₁

1) Erythrocyte parameters

The amount of erythrocytes, hemoglobin level and PVC of chickens intoxicated by Aflatoxin B₁ (group 2, group 3) at the age of 49 days reduced in comparison with those in the control group (Table 3). In the intoxicated groups of chickens with Artichoke application, these indexes in group 4 did not change and in group 5 changed a little.

2) Leucocyte parameters

The amount of leukocytes of chickens in group 3 reduced in comparison with the control group at the

age of 49 days (Table 4). But the difference was not significant. The results of leukocyte formula showed that, the ratio of eosinophil, basophil, monocyte in the trial chickens was not changed. The ratio of neutrophil in chickens intoxicated by Aflatoxin B₁ was much higher, especially in group 3. The latter ratio in intoxicated birds having Artichoke (group 4) was similar to the control group. The opposite results were observed for the ratio of lymphocyte. This ratio reduced in intoxicated birds and got normal for birds having Artichoke (group 4) in comparison with the control group.

3) Levels of GOT, GPT, alkaline phosphatase and plasma bilirubin

The results on Table 5 showed that, the levels of GOT, GPT in blood of intoxicated birds were 2-3 times and the levels of alkaline phosphatase 3-4 times higher than those in blood of healthy birds. These parameters just were a little changed in group 4 and group 5. The same results in plasma bilirubin levels were also observed in this study.

4) Levels of glucose

Concentration of plasma glucose in the chickens of group 2 and 3 (4 and 5) reduced (did not change) after 28 and 49 days of being intoxicated (Table 6).

5) Total plasma protein and protein fractions

The total plasma protein of aflatoxin B₁ intoxicated chicken was showed on Table 7. The result illustrated

Table 3. Effect of Artichoke on erythrocyte parameters of chickens intoxicated by Aflatoxin B₁

Trial groups of chickens	1 Control group 0 ppb Aflatoxin B ₁		2 200 ppb Aflatoxin B ₁		3 500 ppb Aflatoxin B ₁		4 200 ppb Aflatoxin B ₁ + Artichoke		5 500 ppb Aflatoxin B ₁ + Artichoke	
	28	49	28	49	28	49	28	49	28	49
Number of erythrocytes (10 ⁶ /mm ³)	3.17 ±0.33	3.10 ±0.20	2.80 ±0.30	2.75 ±0.43	2.67 ±0.25	2.55 ±0.25	3.20 ±0.30	3.15 ±0.25	3.02 ±0.15	3.00 ±0.20
Hemoglobin (g %)	9.9 ±0.40	9.6 ±0.40	8.9 ±0.30	8.5 ±0.45	8.6 ±0.25	8.0 ±0.15	9.8 ±0.30	9.7 ±0.32	9.6 ±0.20	9.5 ±0.10
PVC (%)	35.0 ±0.17	33.8 ±1.20	29.8 ±2.15	29.3 ±2.67	29.2 ±1.80	28.3 ±1.12	33.5 ±2.50	32.2 ±2.80	34.8 ±0.35	33.2 ±2.10
MVC (∞m ³)	110.41	109.03	106.43	106.55	109.36	110.98	104.70	105.57	112.67	116.49
Hemoglobin Concentration of Erythrocyte (g %)	28.30	28.40	29.87	29.00	29.45	28.27	29.25	28.90	30.77	30.12
Hemoglobin of erythrocyte (pg)	31.23	30.97	31.78	30.91	32.21	31.37	30.62	30.79	31.18	31.67

Table 4. Effect of Artichoke on leucocyte parameters of chickens intoxicated by Aflatoxin B₁

Trial groups of chickens	1 0 ppb Aflatoxin B ₁		2 200 ppb Aflatoxin B ₁		3 500 ppb Aflatoxin B ₁		4 200 ppb Aflatoxin B ₁ + Artichoke		5 500 ppb Aflatoxin B ₁ + Artichoke	
	28	49	28	49	28	49	28	49	28	49
Parameters/Age										
Numbers of leucocytes (10 ³ /mm ³)	29.00 ±3.25	28.70 ±2.30	28.00 ±0.30	30.00 ±2.00	26.00 ±1.50	24.50 ±2.00	27.80 ±1.80	27.20 ±2.00	27.50 ±0.50	27.00 ±1.20
% leucocytes										
Neutrophil	33.20 ±0.80	32.10 ±1.05	34.80 ±1.45	37.30 ±1.20	45.00 ±0.20	45.95 ±0.10	32.15 ±0.48	35.85 ±1.50	43.50 ±0.20	41.70 ±0.20
Eosinophil	8.35 ±0.30	8.20 ±0.14	8.50 ±0.32	9.38 ±0.52	8.50 ±0.15	9.20 ±0.20	7.50 ±0.25	8.70 ±0.15	8.00 ±0.30	8.20 ±0.10
Basophil	0.95 ±0.25	1.30 ±0.33	1.05 ±0.35	1.17 ±0.39	0.50 ±0.25	0.25 ±0.15	1.17 ±0.35	0.83 ±0.25	1.05 ±0.20	1.00 ±0.20
Monocyte	5.03 ±0.32	4.70 ±0.20	5.27 ±0.23	5.30 ±0.18	5.50 ±0.50	5.60 ±0.12	4.90 ±0.30	4.95 ±0.54	5.45 ±0.10	5.30 ±0.10
Lymphocyte	52.47 ±0.70	53.70 ±0.95	50.38 ±1.11	46.85 ±0.75	40.50 ±0.50	39.00 ±1.00	54.28 ±1.20	50.67 ±0.56	42.00 ±0.20	43.80 ±0.30

Table 5. Effect of Artichoke on levels of GOT, GPT, alkaline phosphatase plasma bilirubin of chickens intoxicated by Aflatoxin B₁

Trial groups of chickens	Age	Parameters	sGOT (UI/l)	sGPT (UI/l)	Akaline Phosphatase (UI/l)	Bilirubin (mol/l)
Group 1	28		135.50±2.62	6.00±0.00	1172.00±99.25	4.67±0.22
Controle	49		157.30±5.19	4.67±0.24	1443.00±24.74	5.00±0.67
Group 2	28		194.60±3.02	8.34±0.56	2574.30±48.07	7.33±0.44
200 ppb Aflatoxin B ₁	49		380.30±2.70	7.33±0.47	2711.00±67.78	8.30±0.44
Group 3	28		198.00±3.30	9.00±1.00	3346.00±46.00	9.67±0.22
500 ppb Aflatoxin B ₁	49		387.70±6.70	15.30±0.66	4366.00±82.10	11.67±0.41
Group 4 : 200 ppb Aflatoxin B ₁ + Artichoke	28		151.66±0.87	5.66±0.42	1381.30±56.38	5.30±0.33
Group 5 : 500 ppb Aflatoxin B ₁ + Artichoke	49		160.60±0.42	6.00±0.55	1478.60±30.04	5.00±0.57
Group 2	28		165.70±4.40	6.00±1.00	1485.00±53.20	6.00±0.00
Group 3	49		173.00±4.70	6.30±0.90	1581.00±54.10	6.30±0.33

Table 6. Effect of Artichoke on plasma glucose levels of chickens intoxicated by Aflatoxin B₁

Parameter	Levels of glucose (mg %)					
	Trial groups	1 Control group	2 200 ppb Aflatoxin B ₁	3 500 ppb Aflatoxin B ₁	4 200 ppb Aflatoxin B ₁ + Artichoke	5 500 ppb Aflatoxin B ₁ + Artichoke
Age						
28		165.8±0.55	130.4±0.03	123.3±0.33	156.6±0.04	152.8±0.63
49		166.0±0.17	122.6±0.23	101.5±0.00	152.7±0.32	151.7±0.45

that this parameter in chickens of group 2 and 3 reduced dramatically, whereas in group 4 and 5 it did not change.

The results of electrophoresis showed that, parallel with reduction of total plasma protein, albumin and α₁-globulin also reduced, especially in the chickens intoxicated by 500 ppb Aflatoxin B₁. The γ-globulin in the 500 ppb Aflatoxin B₁ intoxicated chickens reduced in comparison with the control group. The protein fraction did not change considerably in the

chicken added Artichoke extract. The ratio of A/G also changed when the liver was intoxicated by Aflatoxin B₁. This ratio reduced in the intoxicated groups. The changes of A/G in chickens added Artichoke were not clear.

4. Effect of Artichoke on the pathological changes of experimented chickens

At the doses applied (200 ppb and 500 ppb), Afla-

Table 7. Effect of Artichoke on total plasma protein and protein fraction of chickens intoxicated by Aflatoxin B₁

Trial groups	Parameter		Total Protein (g/l)	Plasma protein fractions (g/l)				
	Age	A/G		Albumin	α ₁ -globulin	α ₂ -globulin	β-globulin	γ-globulin
Group 1	28	1.02	35.80±0.05	18.90±0.25	1.30±0.01	5.20±0.35	3.20±0.25	7.20±0.15
Control group	49	1.07	36.40±0.15	18.80±0.17	2.00±0.02	5.60±0.26	2.80±0.08	7.20±0.28
Group 2	28	0.74	27.80±0.21	11.80±0.05	0.90±0.00	5.80±0.17	3.50±0.03	5.80±0.08
200 ppb Aflatoxin B ₁	49	0.64	27.00±0.16	10.50±0.14	1.10±0.01	5.90±0.05	3.00±0.13	6.50±0.16
Group 3	28	0.62	18.30±0.07	7.00±0.03	0.60±0.01	4.20±0.27	2.00±0.02	4.50±0.04
500 ppb Aflatoxin B ₁	49	0.56	17.50±0.51	6.30±0.07	0.50±0.00	4.50±0.19	2.20±0.22	4.00±0.40
Group 4 200 ppb	28	1.15	35.50±0.03	19.00±0.15	1.10±0.01	5.00±0.09	3.20±0.23	7.20±0.18
Aflatoxin B ₁ + Artichoke	49	1.05	35.80±0.05	17.80±0.31	2.00±0.00	5.30±0.00	2.70±0.17	7.00±0.00
Group 5 500 ppb	28	1.06	34.00±0.13	17.50±0.21	1.70±0.03	5.50±0.12	2.80±0.08	6.50±0.25
Aflatoxin B ₁ + Artichoke	49	1.03	32.20±0.31	16.50±0.16	1.20±0.04	5.40±0.07	2.50±0.25	6.60±0.15

Table 8. Residue of Aflatoxin B₁ in liver and muscle of trial chicken

Parameter	Levels of the residue of Aflatoxin B ₁ (ppb)					
	Group	1 Control group 0 ppb Aflatoxin B ₁	2 200 ppb Aflatoxin B ₁	3 500 ppb Aflatoxin B ₁	4 200 ppb Aflatoxin B ₁ + Artichoke	5 500 ppb Aflatoxin B ₁ + Artichoke
Trial samples						
Muscle		0	0	0.32±0.03	0	Non-defined
Liver		0	0	1.57±0.05	0	0.15±0.03

toxin B₁ caused gross and histopathological changes in some organs such as liver, cholecyst, bursa of fabricius, kidney, spleen, thymus and muscle. Reduced weight of the immunological organs like bursa of fabricius, spleen, thymus was considered among others as an indicator of immune suppression. Hepatic damage was constantly found in Aflatoxicosis lesion including yellow discoloration of the liver, degeneration, cholangiolar proliferation, infiltration of inflammation cells. Artichoke extraction was in the position to compensate this effect.

5. Residue of Aflatoxin B₁ in liver and muscle of trial chickens

There has remained 0.32±0.03 ppb, 1.57±0.05 ppb of Aflatoxin B₁ in liver and muscle of the chickens in group 3. Result showed that the liver and muscle of chicken intoxicated with 200 ppb Aflatoxin B₁ and added Artichoke were the same as those in the control group: there was no residue of Aflatoxin B₁.

IV. DISCUSSION

For many years, some reports on veterinary hygiene of feedstuffs noted that most of animal feed has been contaminated by fungi and mycotoxins, especially

with Aflatoxin B₁ (Nguyen Nhu Vien, 1990; Dau Ngoc Hao, 1995). The results of this study illustrated that the effect of Artichoke on limiting toxicity in chicken fed with feed contaminated by 200 ppb~500 ppb Aflatoxin B₁. These concentrations of Aflatoxin B₁ used in this study were much higher than the allowed level (10~20 ppb) of Aflatoxin in chicken feed (Dau Ngoc Hao, 1997).

1. Effect of Artichoke on the growth rate of chickens intoxicated by Aflatoxin B₁

The results of this study showed that chicken fed with Aflatoxin B₁ at the dose of 200~500 ppb clearly decreased chicken growth. Chickens were infected with Aflatoxin B₁ and have drunk water, in which Artichoke extracts was supplemented at the dose of 6 ml of 10% Artichoke per liter have the similar growth rate as that in the control chicken. Therefore Artichoke could limit harmful effect and growth loss in chicken intoxicated by Aflatoxin B₁.

2. Artichoke limits liver damages in chickens intoxicated by Aflatoxin B₁

When animals were intoxicated by Aflatoxin B₁, liver is the first organ to be damaged and most seriously

effected (Claude Moreau, 1980; Doerr, 1983; Robert Glavits, 1992). During the time of experiment chickens were intoxicated by Aflatoxin B₁ at the dose of 200 ppb and 500 ppb, liver was damaged macro and microscopically. Chickens drunk diluted 10% Artichoke at the dose of 6ml per liter had very light level of liver damage at dose 500 ppb Aflatoxin B₁ and at toxin dose 200 ppb liver tissue remained almost normal.

It is well known that, liver participates in coordinator of most metabolic processes in the body that is why when liver is damaged all indexes in relation to liver function will change. Under action of Aflatoxin B₁ 200~500 ppb, activity of enzymes sGOT, sGPT, alkaline phosphatase and serum bilirubin of chicken increase highly while blood glucose, total protein albumine and the ratio of A/G all decrease. When Artichoke has been supplemented, these indexes for intoxicated chickens have been little or not changed in comparison with the control chickens.

The results of this study in macro and microstructure of liver and collected data from Tables 3, 4 and 5 for indexes of liver function lead to the following conclusion: Artichoke could limit harmful effect of Aflatoxin B₁ on liver (Agarwal, 1994; Yasukawa, *et al.*, 1996; Gebhardt, *et al.*, 1997). It may explain that the above mentioned effect of Artichoke is due to active substances of this pharmaceutical material which could lessen pathological disorder, stabilize liver bioprocesses, limit the oxydation, protect cell membrane, keep safety membrane of mitochondria, golgi apparatus and help to decrease liver damage for chicken infected by Aflatoxin B₁.

In short, the role of Artichoke in Aflatoxin B₁ poisoning can be explained as a good, helpful factor for structure and cell function, especially liver function. Artichoke can be understood as a protective substance of liver against harmful substances.

3. Effect of Artichoke on immune system of chicken intoxicated by Aflatoxin B₁

The factors related to immunoresponse of chickens intoxicated by Aflatoxin B₁ 200~500 ppb during our trials have been changed in the following way: weight of thymus, fabricius sac and spleen decrease dramatically (twice), serum globulin decreases, lymphatic

neutrophils increase and lymphopenia.

At the dose of 200 ppb Aflatoxin B₁, Artichoke helps cells, thymus tissue, fabricius sac and spleen to stabilize their structure, neutrophils, lymphocytes and serum globulin keep at the levels equivalent to the control. But at the dose of 500 of Aflatoxin B₁, the changes of the above said indexes remained considerable revealing a weak influence of Artichoke.

All these mentioned above showed that Artichoke containing specific active substances as flavonoid group and other polyphenols have good effect on structure of cells and tissue, first and foremost membrane structure (by action against oxydation). In favors to maintain biofunction of each organ and cell in immune system of trial animals. On the other hand, as said above, liver under action of Artichoke well neutralized toxins, eliminated quickly dregs which help immune organs to operate normally.

Though it is a new finding, it needs to continue the research in order to determine specific effect of Artichoke on immune process of animals. Artichoke in comparison with other products which could limit or inactive Aflatoxin B₁, some remarks can be made as follows: absorbents like active coal, caolin, zeolit mineral and isotopes only have effect to absorb toxins when toxins exist in digestive tract and their limitation is that, they also absorb vitamins, nutrient with the same size; some products like Oltipraz (Buetle T. M. *et al.*, 1996), Curcumin (Firozi P. F. *et al.*, 1996) could limit cancer process caused by Aflatoxin B₁ but it still uses only in human medicine and may has unexpected effects; Mycofix-plus inactivates Aflatoxin B₁ but decreases growth rate in chickens (Dau Ngoc Hao, 1995). Use of Artichoke adding to drinking water of chicken will decrease expenses and, at the same time, have good effect in preventing harmful action caused by Aflatoxin B₁. Besides, Artichoke is a very useful pharmaceutical material for human health presented through our analytic data. In carcass and liver of trial chicken fed with contaminated Aflatoxin B₁ feed 500 ppb and at the same time chicken drunk water which contained Artichoke then the residue of toxin was either very little or not found. So that animal products comply with world trade rules for approved concentration of Aflatoxin B₁ in food (carcass, liver, egg...) is 0.1~0.5 ppb (Dau Ngoc Hao, 1997).

ACKNOWLEDGEMENTS

The author gratefully thanks the Organizing Committee of the Second Congress of Asian Society of Toxicology for a travel grant, lodging and hospitality in Cheju Island, Korea.

REFERENCES

- Agarwal, R., Katiyar, S.K., Lundgren, D.W. and Mukhtar, H. (1994): Inhibitory effect of silymarin, an antihepatotoxic flavonoid, on 12-D-tetradecanoyl phorbol-13-acetate-induced epidermal ornithine decarboxylase activity and mRNA in Sencar mice, *Carcinogenesis*, **15**(6), 1099-1103.
- Buetle, T.M., Bammler, T.K., Hayes, J.D. and Eaton, D.L. (1996): Oltipraz-mediated changes in Aflatoxin B₁ biotransformation in rat liver: implications for human chemointervention, *Cancer-Res.*, **56**(10), 2306-2313.
- Dau Ngoc Hao. (1995): Effects of Micofix plus on Aflatoxin B₁ at varying concentrations in feed for broilers and layers, *Veterinary Science and Techniques.*, **4**(2), 48-57.
- Dau Ngoc Hao. (1997): Influence of foodstuff intoxicated by mycotoxins on animal raising and methods of prevention, *Workshop on feed hygiene influencing on animal product*, held in Hanoi.
- Egner, P.A., DeMatos, P., Groopman, J.D. and Kensler, T.W. (1990): Effect of 1,2-dithiole-3-thione, a monofunctional enzyme inducer, on Aflatoxin DNA adduct formation in rat liver, *Proceedings Annual Meeting of the American Association for Cancer Research.*, 119.
- Firozi, P.F., Aboobaker, V.S. and Bhattacharya, R.K. (1996): Action of curcumin on the cytochrom P₄₅₀ system catalyzing the activation of Aflatoxin B₁, *Chem. Biol. Interact.*, **100**(1), 41- 51.
- Gebhard, R. (1997): Antioxidative and protective properties of extract from leaves of the artichoke (*Cynara scolymus L.*) against hydroperoxide induce oxidative stress in cultured rat hepatocytes, *Toxicology and Applied Pharmacology*, **144**(2), 279-286.
- Huff, W.E.L.F., Kubena, R.B., Harvey, D.E., Corner. and Mollenhauer, H.-H. (1986): Progression of aflatoxicosis in broiler chickens. *Poultry Sci.*, **65**, 1891-1899.
- Le Thi Ngoc Diep. (1999): Pharmacological effect and some applications of Artichoke in veterinary raising, The Ph. D. thesis in Agricultural Science, pp 62-106.
- Nguyen Nhu Vien. (1990): Study on feed contaminated with Aflatoxin B₁ and influence of its toxicity to broiler chickens, The Ph. D. thesis in Agricultural Science, pp 52-86.
- Smith, J.W. and Hamilton, P.B. (1970): Aflatoxicosis in broiler chickens, *Poultry Sci.*, **49**, 207-215.
- Yasukawa, K., Akihisa, T., Oinuma, H., Kaminaga, T., Kanno, H., Kasahara, Y., Tamura, T., Kumaki, K., Yamanouchi, S. and Takido, M. (1996): Inhibitory effect of taraxastane-type triterpenes on tumor promotion by 12-O-tetradecanoylphorbol-13-acetate in two-stage carcinogenesis in mouse skin, *Oncology.*, **53**(4), 341-344.