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The Effects of *in ovo* Nanocurcumin Administration on Oxidative Stress and Histology of Embryonic Chicken Heart

Araghi A[1], Nazaktabar A[1], Sayrafi R[1], Salehi A[2], Golshahi H[3], Jahanbakhsh M[2] & Seifi S[1]

[1]Faculty of Veterinary Medicine, Amol University of Special Modern Technologies, Amol, Iran
[2]Department of Food Safety and Hygiene, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran
[3]Department of Pathology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran

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Corresponding author
Saeed Seifi
saeedseifi57@gmail.com

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Abstract

This study was designed to evaluate the effects of nanocurcumin (NC) on oxidative stress and histology of embryonic chicken heart. NC was injected into the yolk of 4-day-old embryonic eggs at one of three doses: 10 ppm (NC10 group), 100 ppm (NC100 group), and 1000 ppm (NC1000 group). The control group received normal saline. Oxidative stress in heart tissue was evaluated by measuring malondialdehyde (MDA) concentration, glutathione (GSH) content, and ferric reducing antioxidant power (FRAP). Serum lipids and cardio-histolopathogy were also measured. There were no significant differences in GSH, FRAP, and MDA levels between the control and treatment groups ($P > 0.05$). The serum lipid profile was altered in the NC100 group, with reduced levels of triglyceride (TG) ($P < 0.01$) but higher levels of HDL-c ($P < 0.01$) compared to the control. Heart histology was similar between NC10 and NC100 treatments compared to the control group. However, heart sections in NC1000 revealed focal areas of disrupted cardiac muscles and mild infiltration of mononuclear inflammatory cells between muscle fibers. It was concluded that NC at a concentration of 100 ppm did not damage heart tissues in chicken embryo and could be used as a valuable molecule for cardiovascular disease prevention.

Introduction

Curcumin is a yellow pigment and hydrophobic polyphenol derived from *Curcuma longa*, a plant used as a spice, food coloring, medical preparation, and cosmetic compound (Anand*et al.*, 2007; Menon and Sudheer, 2007; Wu *et al.*, 2007). Human (Satoskar *et al.*, 1986; Ramsewak *et al.*, 2000; Menon and Sudheer, 2007) and animal studies (Nabavi *et al.*, 2011; Nautiyal *et al.*, 2011; Yallapu *et al.*, 2012) have detected anti-inflammatory, anti-oxidative, anti-carcinogenic, anti-infection, hypocholesterolaemic and cardio-protective properties of curcumin. Curcumin could be also a therapeutic choice for the treatment of diabetes and neurodegenerative disease (Ghosh *et al.*, 2015).

Animal models and human studies have confirmed that dietary curcumin is safe and does not have side effects, even at high doses (Lao *et al.*, 2006; Ganiger *et al.*, 2007; Wu *et al.*, 2007; Chen *et al.*, 2010). However, few experiments have studied the potential effects of curcumin on embryo development. Some work has demonstrated embryo-toxic and teratogenic effects of curcumin on embryonic development

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in mouse and zebrafish models (Wu *et al*., 2007; Huang *et al*., 2013). In an *in vitro* study, JiangHua *et al.* (2013) revealed that buffalo zygotes displayed developmental defects when exposed to high-dose curcumin (20 μM).

Regardless of the positive effects of curcumin, some studies have shown that curcumin is insoluble in water and has low bioavailability (Yang *et al*., 2007; Shaikh *et al*., 2009; Yallapu *et al*., 2012). These properties of curcumin are limiting factors that can cause low absorption, fast metabolism, and fast systemic elimination from the body. Hence, many types of curcumin have been produced including nano formulations (Liu and Chang, 2011; Liu *et al*., 2013). Some studies in cell culture, animal models, and healthy subjects showed that nanocurcumin (NC) is neutral and has no detrimental effects in high concentrations (Pourasgari *et al*., 2009; Kanai *et al*., 2012; Sarbolouki *et al*., 2012). A literature review also showed that NC has therapeutic efficacy as an anti-inflammatory, anticancer, immunomodulatory, and neuroprotective agent (Bisht *et al*., 2007; Wang *et al*., 2008; Kakkar and Kaur, 2011; Jain *et al*., 2013; Kakkar *et al*., 2013; Sankar *et al*., 2013).

Nonetheless, the consequences of NC administration to embryos remain unclear. Considering the higher efficiency of NC than curcumin, it is very important to evaluate any possible toxicological risk of this product. In this study, we used chicken embryo as an experimental model to investigate the developmental cardio toxicity of NC.

Materials and Methods

Nanocurcumin was obtained from ExirNanoSina in Tehran, Iran (IRC: 1228225765). This compound (SinaCurcumin®) has been produced in Nanotechnology Research Center of Mashhad University of Medical Sciences, Mashhad, Iran.

Experimental design

The experiment was conducted in accordance to protocols approved by Animal Care Committee of Amol University of Special Modern Technologies, Mazandaran, Iran. 60 fertile eggs were obtained from a traditional breeding farm and divided into four groups. The control group received normal saline, and three experimental groups received nanocurcumin in one of three doses: 10 ppm (NC10), 100 ppm (NC100), or 1000 ppm NC (NC1000). The selected doses were chosen based on our previous pilot study (data not published). On the fourth day of incubation, the treatment groups received 0.1 ml of the appropriate dose of NC into the yolk sac while the control group received 0.1 mL saline solution according to methods described by McLaughlin *et al.* (1963). The injection sites were covered by paraffin and the eggs were incubated at 37-38˚C and 60% relative humidity in a forced draught incubator (Noiva *et al.,* 2014).

The eggs were candled one day after injection and then checked every 48 hrs. All 60 fertile eggs hatched on the 21st day of incubation. Blood samples were collected by direct cardiac puncture and sera were obtained by centrifugation at 2800 x *g* for 15 min. Half of the heart tissue from the newly hatched chicks was removed (n = 60) and fixed in 10% buffered formalin for histopathological examination, and the other half was stored at –20˚C until used to assess oxidative stress (n = 60) (Seifi *et al*., 2015). Heart tissues were homogenized in 10x (w/v) sodium phosphate buffer. The homogenate was centrifuged at 1008 x *g* for 15 min, and the supernatant was used to measure indices of oxidative stress.

Measurement of lipid peroxidation

Lipid peroxidation in chick serum was determined by measuring malondialdehyde (MDA) using a thiobarbituric acid reactive substances (TBARS) assay (Abe *et al*., 2014). Briefly, the supernatant of the egg yolk was mixed with 20% trichloroacetic acid, and then centrifuged at 2800 x *g* for 5 min. Then, thiobarbituric acid was added to the supernatant and incubated for 90 min in a 90˚C water bath and cooled down to room temperature. The absorbance was measured at 532 nm. The values are expressed in nmol MDA, using a molar extinction coefficient of 1.56×10^5 MG^1 cmG^1 (Sadighara *et al*., 2013).

Measurement of total glutathione (GSH) content

Glutathione content in heart tissues was measured according to methods described by Gibson *et al.* (1998). The samples were rinsed three times with phosphate buffered saline and mixed with 20% trichloroacetic acid. After centrifugation at 2800 x *g* for 5 min, the supernatant was mixed with 4 volumes of Tris buffer. 1 mM DTNB [5,5′-dithiobis(2-nitrobenzoic acid)] was then added to the

samples and incubated for 30 min. Absorbance was read at 412 nm.

Ferric reducing antioxidant power (FRAP) measurement

The antioxidant capacity of heart tissue samples was determined by measuring the ability of samples to reduce Fe^{3+} to Fe^{2+}. The combination between Fe^{2+} and 2, 4, 6-tris-(2-pyridyl)-1, 3, 5-triazine (TPTZ) gave a blue color and absorbance was read at 593 nm (Benzie *et al.*, 1996).

Serum lipid profile determination

Total cholesterol content was estimated according to methods described by Turley *et al.* (1994). Low density lipoprotein cholesterol (LDL-c) and high density lipoprotein cholesterol (HDL-c) were measured in serum according to the Wyne and Woollett (1998) method. Triglyceride (TG) content was measured using modified methods from Hermann *et al*. (2000).

Statistical analysis

All experimental samples were repeated in triplicate. All results are expressed as mean ± SD. Statistical analyses were performed by employing Student's t test for unpaired data using the SPSS (2006) 16.0 software package. Significance was established at the $P < 0.05$ level.

Results and Discussion

There were no gross abnormalities in chicken embryos after necropsy. Oxidative stress variables including MDA, FRAP, and GSH are shown in Table 1. Levels of MDA and antioxidants were similar between NC treatment groups and the control group ($P > 0.05$). Although GSH content was higher in the groups exposed to NC than the control, this difference was insignificant ($P > 0.05$). Glutathione is a tripe tide antioxidant that protects tissues against oxidative damage (Kidd, 1997). Flora *et al.* (2013) reported no changes in GSH content and TBARS (a lipid peroxidation marker) levels in mice treated with nanocurcumin (15 mg/kg, orally) throughout the experimental period of 14 days. Another study demonstrated that nanocurcumin-treated cardiomyoblasts H9c2 cells had reduced lipid peroxidation without alterations in GSH (Nehra *et al.*, 2015).

Table 1. Effects of nanocurcumin on antioxidant status in heart of chicken embryo

Groups	MDA (nmol/g sample)	GSH (µmol/g sample)	FRAP (mmol/g sample)
Control	0.17 ± 0.05	0.28 ± 0.12	1.044 ± 0.46
NC10	0.18 ± 0.05	0.036 ± 0.13	0.903 ± 0.25
NC100	0.18 ± 0.03	0.31 ± 0.10	1.32 ± 0.38
NC1000	0.19 ± 0.01	0.33 ± 0.11	1.27 ± 0.34

Values are presented as Mean ± SD

Control group: without injection of Nanocurcumin, NC10, NC100 and NC1000 groups were injected with 10, 100, and 1000 ppm NC into the yolk.

The effects of nanocurcumin on the serum lipid profile are shown in Table 2. The levels of TC and LDL-c were similar across all groups ($P > 0.05$). Although TG levels were lower in the NC treated groups than the control group, this difference was only significant in the NC100 group ($P < 0.01$). The levels of HDL-c were significantly ($P < 0.01$) higher in NC100 group compared to the control and NC10 groups. In line with the present study, Rahimi *et al.*, (2016) showed an increase in HDL-c and decrease in TG in diabetic patients that received 80 mg/day of curcumin as nano-micelle. Several studies have shown that curcumin may have a protective effect against cardiovascular disease like myocardial infarction, hypertension, and diabetic cardiomyopathy, and NC has been proven to be effective in treatment of different diseases such as cardiovascular disease (Nabavii *et al.*, 2011; Yallapu *et al.*, 2012; Nehra *et al.*, 2015; Xiao *et al.*, 2016). Moreover, protective effects of curcumin on serum lipid fractions were also shown in healthy humans (Soni and Kuttan, 1992), experimental hepatic fibrosis (Akila *et al.*, 1998), and normal and hyper lipidemic rats (Ghada, 2005).

Histopathological evaluations revealed that the heart sections from NC10 and NC100 groups were similar to the control group and displayed normal appearance (Fig. A, B, C). In brief, cardiac muscle fibers were well arranged with centrally located nuclei. Connective tissue also appeared normal. Examination of the heart sections in the NC1000 group revealed focal

areas of disrupted cardiac muscle fibers, mild degeneration changes, and fragmentation in the cardiac muscle fibers (Figure D). Mild infiltration of mononuclear inflammatory cells was also detected between muscle fibers. Similar to our results, Ding et al. (2014) found intravenous administration of Curcumin Poly (ester amine) nanoparticles at low concentration (25 ppm) in the BALB/c mice did not induce any histological damage in heart tissue.

Table 2. Effects of nanocurcumin levels on serum lipid profile of chicken embryo

Groups	TC	TG	HDL-c	LDL-c
	mg/dL	mg/dL	mg/dL	mg/dL
Control	448.45 ± 78.39	105.48 ± 33.05	134.25 ± 20.31	336.75 ± 119.54
NC10	483.27 ± 80	64.2 ± 23.32	127.25 ± 20.02	406.81 ± 149.87
NC100	399.91 ± 68	42.63 ± 12.37*	173.88 ± 19.77**	252.77 ± 109.14
NC1000	477.34 ± 71.50	52.8 ± 18.45	148.00 ± 7.87	344.75 ± 128.42

Values are presented as Mean ± SD.
Control group: without injection of Nanocurcumin, NC10, NC100 and NC1000 groups were injected with 10, 100, and 1000 ppm NC into the yolk.
*Significantly decreased in NC100 group compared with that in control group ($P < 0.01$).
**Significantly increased in NC 100 group compared with that in NC 10 and control groups ($P < 0.01$).
Total cholesterol (TC), Triglyceride (TG), Low density lipoprotein cholesterol (LDL-c) and High density lipoprotein cholesterol (HDL-c).

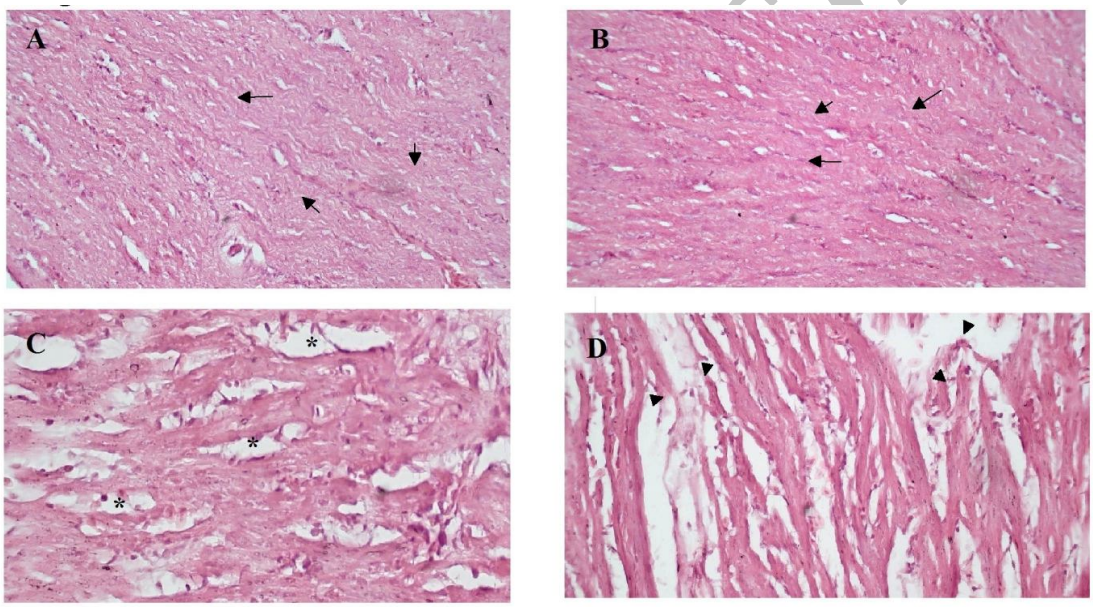

Figure 1. Histopathological evaluation of the heart sections. **(A):** Control group, well-arranged cardiac muscle fibers (arrow) (H & E, ×100). **(B):** NC 10 group, normal cardiac structure with the same appearance compared to control group. Well-organized muscle fibers can be detected with arrows (H & E, ×100). **(C):** NC 100 group, normal cardiac structure and many vascular structure (star) exist between cardiac muscles (H & E, ×400). **(D):** NC1000 group, focal areas of disrupted cardiac muscle fibers and fragmentation of the cardiac muscle fibers (head arrow) (H & E, ×400).

Conclusion

The use of nanotechnology in medicine is expected to spread quickly. This study assessed the effects of nanocurcumin on oxidative stress and histopathological evaluation in an *in ovo* model. We show that nanocurcumin at a concentration of 100 ppm significantly decreases TG and enhances HDL-c in blood serum, and therefore has potential to be conducive for cardiovascular disease prevention. However, a higher dose (1000 ppm) could be degenerative.

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References

Abe C, Uto Y, Kawasaki A, Noguchi C, Tanaka R, Yoshitomi T, Nagasaki Y, Endo Y & Hori H. 2014. Evaluation of the *in vivo* antioxidative activity of redox nanoparticles by using a developing chicken egg as an alternative animal model. Journal of Controlled Release, 182: 67-72. DOI: 10.1016/j.jconrel.2014.03.015

Akila G, Rajakrishnan V, Viswanathan P, Rajashekaran K & Menon VP. 1998. Effects of curcumin on lipid profile and lipid peroxidation status in experimental hepatic fibrosis. Hepatology research, 11: 147-157.

Anand P, Kunnumakkara AB, Newman RA & Aggarwal BB. 2007. Bioavailability of curcumin: problems and promises. Molecular pharmaceutics, 4: 807-818. DOI: 10.1021/mp700113r

Bisht S, Feldmann G, Soni S, Ravi R, Karikar C, Maitra A & Maitra A. 2007. Polymeric nanoparticle-encapsulated curcumin ("nanocurcumin"): a novel strategy for human cancer therapy. Journal of Nanobiotechnology, 5: 1-18. DOI: 10.1186/1477-3155-5-3

Benzie IF, Strain JJ. 1996. The ferric reducing ability of plasma (FRAP) as a measure of "antioxidant power": the FRAP assay. Analitical Biochemistry, 239:70–76.

Chen CC, Hsieh MS, Hsuuw YD, Huang FJ, & Chan WH. 2010. Hazardous effects of curcumin on mouse embryonic development through a mitochondria-dependent apoptotic signaling pathway. International Journal of Molecular Sciences, 11: 2839-2855. DOI: 10.3390/ijms11082839

Ding Q, Niu T, Yang Y, Guo Q, Luo F & Qian Z. 2014. Preparation of curcumin-loaded poly(ester amine) nanoparticles for the treatment of anti-angiogenesis. Journal of Biomedical Nanotechnology, 10: 632-641. DOI: 10.1166/jbn.2014.1829

Flora G, Gupta D & Tiwari A. 2013. Preventive efficacy of bulk and nanocurcumin against lead-induced oxidative stress in mice. Biological Trace Element Research, 152: 31-40. DOI: 10.1007/s12011-012-9586-3

Ganiger S, Malleshappa HN, Krishnappa H, Rajashekhar G, Rao VR & Sullivan F. 2007. A two generation reproductive toxicity study with curcumin, turmeric yellow, in Wistar rats. Food and Chemical Toxicology, 45: 64-69. DOI: 10.1016/j.fct.2006.07.016

Ghada Z. 2005. Effect of curcumin, mixture of curcumin and piperine and curcum (turmeric) on lipid profile of normal and hyperlipidemic rats. Egyptian Journal of Hospital Medicine, 21: 145-161.

Ghosh S, Banerjee S & Sil PC. 2015. The beneficial role of curcumin on inflammation, diabetes and neurodegenerative disease: A recent update. Food and Chemical Toxicology, 83: 111-124. DOI: 10.1016/j.fct.2015.05.022

Gibson XA, Shartava A, McIntyre J, Monteiro CA, Zhang Y, Shah A &Goodman SR. 1998. The efficacy of reducing agents or antioxidants in blocking the formation of dense cells and irreversibly sickled cells in vitro. Blood, 91: 4373-4378.

Hermann M, Mahon MG, Lindstedt KA, Nimpf J & Schneider WJ. 2000. Lipoprotein receptors in extraembryonic tissues of the chicken. Journal of Biological Chemistry, 275: 16837-16844. DOI: 10.1074/jbc.M000163200

Huang FJ, Lan KC, Kang HY, Liu YC, Hsuuw YD, Chan WH & Huang KE. 2013. Effect of curcumin on *in vitro* early post-implantation stages of mouse embryo development. European Journal of Obstetrics & Gynecology and Reproductive Biology, 166: 47-51. DOI: 10.1016/j.ejogrb.2012.09.010

Jain K, Sood S & Gowthamarajan K. 2013. Modulation of cerebral malaria by curcumin as an adjunctive therapy. The Brazilian Journal of Infectious Diseases, 17: 579-591. DOI: 10.1016/j.bjid.2013.03.004

JiangHua S, ChunYan Y, HaiYing Z, Jian W, FenXiang H, BingZhuang Y & XiangWei L. 2013. Effects of curcumin on buffalo embryonic development in vitro. Paper presented at the Buffalo Bulletin.

Kakkar V & Kaur IP. 2011. Evaluating potential of curcumin loaded solid lipid nanoparticles in aluminium induced behavioural, biochemical and histopathological alterations in mice brain. Food and Chemical Toxicology, 49: 2906-2913. DOI: 10.1016/j.fct.2011.08.006

Kakkar V, Mishra AK, Chuttani K & Kaur IP. 2013. Proof of concept studies to confirm the delivery of curcumin loaded solid lipid nanoparticles (C-SLNs) to brain. International Journal of Pharmaceutics, 448: 354-359. DOI: 10.1016/j.ijpharm.2013.03.046

Kanai M, Imaizumi A, Otsuka Y, Sasaki H, Hashiguchi M, Tsujiko K, Matsumoto S, Isiguro H & Chiba T. 2012. Dose-escalation and pharmacokinetic study of nanoparticle curcumin, a potential anticancer agent with improved bioavailability, in healthy human volunteers. Cancer Chemotherapy and Pharmacology, 69: 65-70. DOI: 10.1007/s00280-011-1673-1

Kidd PM. 1997. Glutathione: systemic protectant against oxidative and free radical damage. Alternative Medicine Review, 2: 155-176.

Lao CD, Demierre MF & Sondak VK. 2006. Targeting events in melanoma carcinogenesis for the prevention of melanoma. Expert Review of Anticancer Therapy, 6: 1559-1568. DOI: 10.1586/14737140.6.11.1559

Liu CH & Chang FY. 2011. Development and characterization of eucalyptol microemulsions for topic delivery of curcumin. Chemical and Pharmaceutical Bulletin, 59: 172-178. DOI: 10.1248/cpb.59.172

Liu J, Chen S, Li L, Song L, Guo S & Huang S. 2013. Recent progress in studying curcumin and its nano-preparations for cancer therapy. Current Pharmaceutical Design, 19: 1974-1993. DOI: 10.2174/138161213805289327

McLaughlin J, Marliac JP, Verrette MJ, Mutchler MK, & Fitzhugh OG. 1963. The injection of chemicals into the yolk sac of fertile eggs prior to incubation as a toxicity test. Toxicology and Applied Pharmacology, 5: 760-771. DOI: 10.1016/0041-008X(63)90068-1

Menon VP & Sudheer AR. 2007. Antioxidant and anti-inflammatory properties of curcumin. Advances in Experimental Medicine and Biology, 595:105-125. DOI: 10.1007/978-0-387-46401-5_3

Nabavi SF, Nabavi SM, Ebrahimzadeh MA, Eslami S, Jafari N & Moghaddam HA. 2011. The protective effect of curcumin against sodium fluoride-induced oxidative stress in rat heart. Archives of Biological Sciences, 63: 563-569. DOI: 10.2298/ABS1103563N

Nautiyal J, Banerjee S, Kanwar SS, Yu Y, Patel BB, Sarkar FH& Majumdar AP. 2011. Curcumin enhances dasatinib-induced inhibition of growth and transformation of colon cancer cells. International Journal of Cancer, 128: 951-961. DOI: 10.1002/ijc.25410

Nehra S, Bhardwaj V, Kalra N, Ganju L, Bansal A, Saxena S & Saraswat D. 2015. Nanocurcumin protects cardiomyoblasts H9c2 from hypoxia-induced hypertrophy and apoptosis by improving oxidative balance. Journal of Physiology and Biochemistry, 71: 239-251.

Noiva RM, Menezes AC, Peleteiro MC. 2014. Influence of temperature and humidity manipulation on chicken embryonic development. BMC Veterinary Research, 10: 234. DOI: 10.1186/s12917-014-0234-3

Pourasgari F, Ahmadian S, Salmanian AH, Sarbolouki MN & Massumi M. 2009. Low cytotoxicity effect of dendrosome as an efficient carrier for rotavirus VP2 gene transferring into a human lung cell line. Molecular Biology Reports, 36: 105-109. DOI: 10.1007/s11033-007-9157-4

Rahimi HR, Mohammadpour AH, Dastani M, Jaafari MR, Abnous K, Ghayour Mobarhan M & Kazemi Oskuee R. 2016. The effect of nano-curcumin on HbA1c, fasting blood glucose, and lipid profile in diabetic subjects: a randomized clinical trial. Avicenna Journal of Phytomedicine, 6: 567-577.

Ramsewak RS, DeWitt DL, & Nair MG. 2000. Cytotoxicity, antioxidant and anti-inflammatory activities of Curcumins I–III from *Curcuma longa*. Phytomedicine, 7: 303-308. DOI: 10.1016/S0944-7113(00)80048-3

Sadighara P, Jahed Khaniki G, Baseri E, Dehghani MH, Barin A & Mazaheri Nezhad Fard R. 2013. Effect of bisphenol A on the quality characteristics of meat in a chicken embryo model. Science International, 1: 375-378. DOI: 10.17311/sciintl.2013.375.378

Sankar P, Telang AG, Suresh S, Kesavan M, Kannan K, Kalaivanan R & Sarkar SN. 2013. Immunomodulatory effects of nanocurcumin in arsenic-exposed rats. International Immunopharmacology, 17: 65-70. DOI: 10.1016/j.intimp.2013.05.019

Sarbolouki MN, Alizadeh AM, Khaniki M, Azizian S & Mohaghgheghi MA. 2012. Protective effect of dendrosomal curcumin combination on colon cancer in rat. Tehran University Medical Journal, 69: 678-685.(In persian with English abstract)

Satoskar RR, Shah SJ & Shenoy SG. 1986. Evaluation of anti-inflammatory property of curcumin (diferuloyl methane) in patients with postoperative inflammation. International Journal of Clinical Pharmacology, Therapy, and Toxicology, 24: 651-654.

Seifi S, Araghi A, Sayrafi R & Salehi A. 2015. Effects of rice bran oil on qualitative

properties of heart and breast muscle tissues in chicken embryo model. International Food Research Journal, 22:1894-1897.

Shaikh J, Ankola DD, Beniwal V, Singh D & Ravi Kumar MNV. 2009. Nanoparticle encapsulation improves oral bioavailability of curcumin by at least 9-fold when compared to curcumin administered with piperine as absorption enhancer. European Journal of Pharmaceutical Sciences, 37: 223-230. DOI: 10.1016/j.ejps.2009.02.019

Soni KB & Kuttan R. 1992. Effect of oral curcumin administration on serum peroxides and cholesterol levels in human volunteers. Indian Journal of Physiology and Pharmacology, 36: 273-273.

SPSS (Statistical Packages for the Social Sciences) 2006.SPSS for Windows Release 16.0. SPSS Inc. Chicago.

Turley SD, Herndon MW & Dietschy JM. 1994. Reevaluation and application of the dual-isotope plasma ratio method for the measurement of intestinal cholesterol absorption in the hamster. Journal of Lipid Research, 35: 328-339.

Wang X, Jiang Y, Wang YW, Huang MT, Ho CT & Huang Q. 2008. Enhancing anti-inflammation activity of curcumin through O/W nanoemulsions. Food Chemistry, 108: 419-424. DOI: 10.1016/j.foodchem.2007.10.086

Wu JY, Lin CY, Lin TW, Ken CF & Wen YD. 2007. Curcumin affects development of zebrafish embryo. Biological and Pharmaceutical Bulletin, 30: 1336-1339. DOI: 10.1248/bpb.30.1336

Wyne KL & Woollett LA. 1998. Transport of maternal LDL and HDL to the fetal membranes and placenta of the Golden Syrian hamster is mediated by receptor-dependent and receptor-independent processes. Journal of Lipid Research, 39: 518-530.

Xiao J, Sheng X, Zhang X, Guo M & Ji X. 2016. Curcumin protects against myocardial infarction-induced cardiac fibrosis via SIRT1 activation in vivo and in vitro. Drug Design, Development and Therapy, 10: 1267-1277. DOI: 10.2147/DDDT.S104925

Yallapu MM, Jaggi M & Chauhan SC. 2012. Curcumin nanoformulations: a future nanomedicine for cancer. Drug Discovery Today, 17: 71-80. DOI: 10.1016/j.drudis.2011.09.009

Yang KY, Lin LC, Tseng TY, Wang SC & Tsai TH. 2007. Oral bioavailability of curcumin in rat and the herbal analysis from Curcuma longa by LC–MS/MS. Journal of Chromatography B, 853: 183-189. DOI: 10.1016/j.jchromb.2007.03.010

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بررسی اثرات تزریق داخل تخم مرغ نانوکورکومین بر استرس اکسیداتیو و بافت شناسی قلب در جنین جوجه

Araghi A[1], Nazaktabar A[1], Sayrafi R[1], Salehi A[2], Golshahi H[3], Jahanbakhsh M[2] & Seifi S[1]

[1] دانشکده دامپزشکی، دانشگاه فناوری‌های نوین آمل، آمل، ایران
[2] گروه بهداشت و سلامت غذایی، مرکز بهداشت عمومی، علوم دارویی دانشگاه تهران، تهران، ایران
[3] گروه پاتولوژی، دانشکده دامپزشکی، دانشگاه تهران، تهران، ایران

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چکیده

این مطالعه به منظور ارزیابی اثرات نانوکورکومین بر استرس اکسیداتیو و بافت شناسی قلب جنین جوجه طراحی شد. نانوکورکومین در زرده تخم‌مرغ جنین دار ۴ روزه در سه دوز ۱۰ ppm، ۱۰۰ ppm و۱۰۰۰ ppm تزریق شد. گروه شاهد به همان روش نرمال سالین دریافت کردند. استرس اکسیداتیو عضله قلب با اندازه‌گیری مالون‌دی‌آلدئید، گلوتاتیون و توان آنتی‌اکسیدانی احیاء آهن ارزیابی شد. همچنین چربی‌های سرم و هیستوپاتولوژی عضله قلب مورد بررسی قرار گرفت. اختلاف آماری معنی‌داری بین سطوح گلوتاتیون، مالون‌دی‌آلدئید و توان آنتی‌اکسیدانی احیاء آهن در گروه‌های تیمار و شاهد وجود نداشت ($P > ۰/۰۵$). پروفایل چربی سرم در گروه ۱۰۰۰ ppm تغییر کرد و میزان تری گلیسیرید نسبت به گروه شاهد کمتر ($P < ۰/۰۱$) و میزان HDL-c نسبت به گروه شاهد بیشتر ($P < ۰/۰۱$) شد. بافت شناسی عضله قلب در گروه‌های ۱۰ppm و ۱۰۰ppm و گروه شاهد مشابه بود ولی در گروه ۱۰۰۰ppm درهم گسیختگی ماهیچه‌های قلبی و نفوذ ملایم سلول‌های التهابی تک هسته‌ای بین فیبرهای عضلانی مشخص بود. می‌توان نتیجه‌گیری کرد که نانوکورکومین در غلظت ۱۰۰ppm به بافت عضله قلب جنین جوجه صدمه‌ای نمی‌زند و می‌تواند به عنوان یک ماده با ارزش در جلوگیری از بیماری‌های قلبی- عروقی مطرح باشد.

کلمات کلیدی
نانوکورکومین
استرس اکسیداتیو
جنین جوجه

نویسنده مسئول
Saeed Seifi
saeedseifi57@gmail.com

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