

• 实验研究 •

玉米蜂花粉对大鼠红细胞膜
结构和功能的影响

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内容提要 本实验观察了喂饲含10%玉米蜂花粉的饲料对正常成年大鼠红细胞膜ATP酶活性及红细胞膜巯基(-SH)和唾液酸含量等的影响。实验结果表明,喂养10周后,花粉组大鼠红细胞膜 Na^+ , K^+ -ATP酶和 Ca^{2+} , Mg^{2+} -ATP酶活性分别为 311.5 ± 35.5 和 $813.8 \pm 43.4 \text{ nmolPi/mg protein} \cdot \text{h}$,均明显高于对照组(209.9 ± 23.9 和 $624.9 \pm 23.3 \text{ nmolPi/mg protein} \cdot \text{h}$);红细胞膜-SH和唾液酸的含量都显著高于对照组;同时红细胞膜MDA含量明显低于对照组。结果提示,玉米蜂花粉对细胞膜的结构和功能具有较好的保护作用,这种保护作用可能是通过抑制脂质过氧化作用而实现的。

关键词 玉米蜂花粉 红细胞膜 ATP酶 脂质过氧化

蜂花粉是蜜蜂从蜜源植物中采集的花粉颗粒,是蜜蜂赖以生存所必需的蛋白质、脂肪和碳水化合物等营养物质的主要来源。已有资料表明,蜂花粉具有促进生长、抗辐射损伤、增强免疫功能和抗衰老等作用^①。自由基学说是目前公认的最重要的衰老学说之一,自由基及其引发的脂质过氧化物(LPO)对生物膜有多种危害,可以破坏膜结构,进而影响其功能。本实验观察了玉米蜂花粉对大鼠红细胞膜结构和功能的影响,进一步探讨玉米蜂花粉抗衰老的作用机理。

材料与方 法

一、蜂花粉:玉米蜂花粉由山西省农业科学院园艺所提供并鉴定。

二、动物、饲料及分组:选用本研究室自行繁殖饲养的5月龄雄性Wistar大鼠12只,按体重随机分成对照组和花粉组,每组6只。对照组喂饲基础饲料,花粉组喂饲含10%玉米蜂花粉的基础饲料。动物自由进食和饮水,每周称体重1次。饲养10周后,动物腹主动脉采血,制备红细胞膜,测定有关生化指标。

基础饲料的组成:74%次标准粉 15%脱脂奶粉 5%植物油 2%粗纤维 3%混合无机盐 0.5%混合微量元素 0.5%混合维生素。

三、实验方法

1.红细胞膜的制备:参照Dodge的方法^②。

2.红细胞膜ATP酶活性的测定:采用Schmalzing的方法^③。由测定ATP酶所催化的ATP末端磷酸,经水解释放出的无机磷含量来表示。其中,磷的测定采用Muszbek的方法^④,膜蛋白的测定采用改良的Lowry法^⑤,酶活性单位以 $\text{nmolPi} \cdot \text{mg protein} \cdot \text{h}$ 表示。

3.红细胞膜巯基(-SH)含量的测定:参考Chan的方法^⑥。

4.红细胞膜唾液酸含量的测定:采用Bialsche试剂直接法^⑦。

5.红细胞膜丙二醛(MDA)含量的测定:使用Mengel的方法^⑧。

结 果

一、大鼠红细胞膜 Na^+ , K^+ -ATP酶和 Ca^{2+} , Mg^{2+} -ATP酶活性变化:表1显示,花粉组两种酶的活性均

表1 大鼠红细胞膜ATP酶活性 ($\bar{x} \pm S\bar{x}$)

组别	动物数	酶活性($\text{nmolPi/mg pro} \cdot \text{h}$)	
		Na^+ , K^+ -ATP酶	Ca^{2+} , Mg^{2+} -ATP酶
对照	6	209.9 ± 23.9	624.9 ± 23.3
花粉	6	$311.5 \pm 35.5^*$	$813.8 \pm 43.4^*$

注:与对照组相比, * $P < 0.05$

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高于对照组。

二、大鼠红细胞膜-SH、唾液酸及MDA含量变化:表2结果表明,花粉组大鼠红细胞膜-SH和唾液

酸含量均明显高于对照组,-SH含量增高的趋势更加显著。同时花粉组大鼠红细胞膜MDA含量明显低于对照组。

表2 大鼠红细胞膜-SH、唾液酸及MDA含量 ($\bar{x} \pm S\bar{x}$)

组别	动物数	-SH(nmol/mg pro)	唾液酸(μ g/mg pro)	MDA(nmol/g Hb)
对照	6	76.38 \pm 8.76	16.67 \pm 1.85	3.73 \pm 0.36
花粉	6	140.43 \pm 13.13**	21.08 \pm 1.27*	2.32 \pm 0.21*

注:与对照组相比,* $P < 0.05$,** $P < 0.01$

讨 论

近年来的研究表明,自由基反应是许多疾病和损伤的病理基础^[9]。脂质过氧化作为自由基损伤的重要方式之一日益受到人们的重视。生物体内不饱和脂肪酸主要存在于生物膜的类脂中,因而生物膜成为脂质过氧化损伤的主要部位。自由基及脂质过氧化的最终分解产物MDA可以严重损伤膜的结构,影响膜的功能。

Na⁺,K⁺-ATP酶是一种对热不敏感的膜标志酶,广泛分布于生物体内。它以ATP为能源,跨膜转运Na⁺和K⁺,维持细胞内外渗透压平衡和跨膜电化学梯度,从而保证了机体各种生理功能的正常进行及能量代谢的需要。Ca²⁺,Mg²⁺-ATP酶是细胞膜上另一种重要的酶,是钙泵的一部分,它的基本功能是将细胞内的Ca²⁺主动转运至细胞外,使细胞内呈低Ca²⁺状态,以维持细胞的正常生理功能。Catherine研究表明,当细胞膜发生脂质过氧化后,膜上ATP酶活动降低^[10]。从本实验结果可以看出,花粉组大鼠红细胞膜Na⁺,K⁺-ATP酶和Ca²⁺,Mg²⁺-ATP酶活性明显高于对照组($P < 0.05$)。这可能是由于玉米蜂花粉抑制了机体的脂质过氧化过程,从而减轻了脂质过氧化作用对生物膜的损伤。实验结果还表明,花粉组大鼠红细胞膜MDA含量明显低于正常对照组,比对照组减少37.7%。提示玉米蜂花粉对大鼠体内脂质过氧化反应有明显的抑制作用。

-SH是动物及人体物质代谢过程中起重要作用的酶活性中心的组分,是酶活力所必需的基团。-SH具有保护细胞膜免受过氧化损伤的作用,膜上-SH含量的减少是细胞膜受到氧化损伤的重要表现。唾液酸是细胞膜糖蛋白末端糖链残基,位于细胞的外表面,参与细胞的识别、粘着和接触抑制。唾液酸也是循环系统中红细胞存活的主要决定因素,在红细胞的生命周期中,新生红细胞的唾液酸含量比衰老者高。本实验

中花粉组大鼠红细胞膜-SH和唾液酸的含量明显高于对照组,分别比对照组提高了45.7%和20%。提示玉米蜂花粉可以保护细胞膜免受脂质过氧化反应的损伤,维持细胞膜的结构和功能,延缓细胞的衰老过程。

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Ligusticum wallichii has the effects of increasing cerebral blood flow, accelerating the velocity of blood flow, dilating the spastic artery and decreasing peripheral arterial resistance. Both of them has the functions of decreasing the levels of thromboxane $B_2(TXB_2)$, β -thromboglobulin (β -TG) and platelet factor IV (PF_4) in plasma and increasing the concentration of 6-keto-prostaglandin $F_{1\alpha}$ (6 keto-PGF $_{1\alpha}$) in plasma, the effect of *Ligusticum wallichii* was significantly better than Aspirin ($P < 0.05$).

Key words transient ischemic attack, *Ligusticum wallichii*, Aspirin

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Effect of Zea Pollinium on the Structure and Function of Erythrocyte Membrane in Rats

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The aged-related changes of ATPase activity as well as the contents of MDA, sulfhydryl and sialic acid of erythrocyte membrane had been observed in many studies. In this paper, the effect of Zea pollinium on the structure and function of erythrocyte membrane in rats was observed. 12 male rats were divided randomly into pollen and control groups, the former was fed with diet containing 10% Zea pollinium; while no pollen for the latter. Results: After feeding for 10 weeks, the Na^+ , K^+ -ATPase and Ca^{2+} , Mg^{2+} -ATPase activities were 311.5 ± 35.5 and 813.8 ± 43.4 nmolPi/mg protein \cdot h respectively in pollen group, significantly higher than that of the control group (209.9 ± 23.9 and 624.9 ± 23.3 nmolPi/mg protein \cdot h). The contents of sulfhydryl and sialic acid were also increased, but the content of MDA was markedly decreased with the use of Zea pollinium. These results indicated that Zea pollinium could inhibit formation of lipid peroxides, protect the structure and function of erythrocyte membrane from the injury of peroxide.

Key words Zea pollinium, erythrocyte membrane, ATPase, lipid peroxidation

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Experimental Study of Modified Yu Ping Feng San(玉屏风散) on Antibacterial Adhesion of Tracheal Mucosa in Mice Model of Chronic Bronchitis

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In order to observe the influence of modified Yu Ping Feng San (MYPFS) on bacterial adhesion of tracheal mucosa, four experiments of bacterial adhesion in pneumatic tract were conducted, in which mice of chronic bronchitis model (CBM) induced by SO_2 stimulation and another health control group breathed in aerosol contained *Pseudomonas aeruginosa* under the same condition were observed. The results showed that, with scanning electron microscopy, ultrastructural lesions on tracheal mucosa surface and adhesive bacterial number in CBM administrated MYPFS were far less than that in CBM without MYPFS ($P < 0.001$), and quantitative culture of *Pseudomonas aeruginosa* with tracheal tissue homogenate was also markedly reduced. However, the tracheal mucosa of healthy control animals were intact, the adhesive bacteria were not found. It is suggested that bacterial adhesion was closely related to the injury of tracheal mucosa, and MYPFS could play a role of anti-bacterial adhesion through the protection of tracheal mucosa epithelium or reduction of pneumatic tract injury. These were quite in accordance with the theories of traditional Chinese medicine in "strengthening body resistance to eliminate the pathogenic factor", so that they provided experimental evidence for TCM tonics to prevent and treat infection of respiratory tract.

Key words experimental chronic bronchitis, bacterial adhesion, modified Yu Ping Feng San

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