

不同抗氧化活性蔬菜对衰老机体抗氧化防御体系功能改善作用的比较研究

郭长江

(卫生学环境医学研究所)

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卫生学环境医学研究所, 天津
郭长江, 韦京津, 吉琳琳, 高蔚卿, 杨继军,
吴健全, 刘晋, 唐振闻, 刘阳

蔬菜的营养作用

维生素
矿物质
膳食纤维
碳水化合物



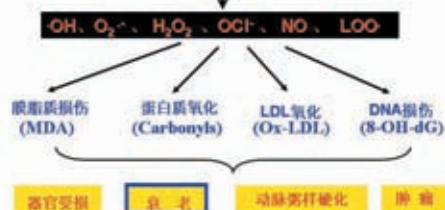
提供植物化学物
抗氧化作用

Systematic Review Meta Analysis



“自由基损伤学说”

正常代谢 氧的利用 紫外线 吸烟
金属离子 放射线 应激 空气污染等



衰老自由基学说



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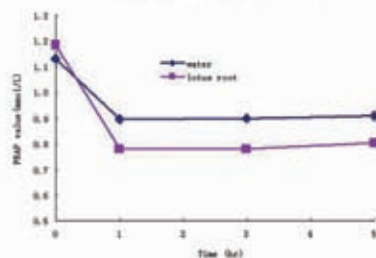
AGING: A THEORY BASED ON FREE RADICAL AND RADIATION CHEMISTRY
(Abstracts: 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 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Multivariate regression analysis between the FRAP value and contents of ascorbic acid, phenolics and flavonoids in water extracts

Variable	β	S.E	Beta	t	P
Constant	-1.406	0.489	-	-2.877	0.008*
Ascorbic acid	1.255E-02	0.006	0.284	2.251	0.033*
Phenolics	3.655E-02	0.010	0.454	3.511	0.001*
Flavonoids	2.223E-02	0.011	0.290	1.939	0.062

*Significant Difference, *P<0.05

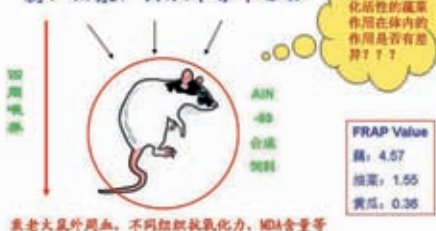
连续七天灌胃藕汁对老龄大鼠血清抗氧化活性的影响

Effect of different cooking methods on the antioxidant capacity of vegetables (mmol/FeSO₄/kgFW, n=3)

组别	蔬菜	煮	炒	蒸	炖	煎	炸
I	菠菜	0.00000	1.20000**	0.00000	0.00000	0.00000	0.00000
	油菜	0.00000	1.00000**	0.00000	0.00000	0.00000	0.00000
	黄瓜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
II	菠菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	油菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	黄瓜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
III	菠菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	油菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	黄瓜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
IV	菠菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	油菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	黄瓜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
V	菠菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	油菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	黄瓜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
VI	菠菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	油菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	黄瓜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
VII	菠菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	油菜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	黄瓜	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

三种蔬菜对老龄大鼠抗氧化功能的影响

藕、油菜、黄瓜冷冻干燥粉



衰老大鼠外周血, 不同组织抗氧化力、MDA含量等

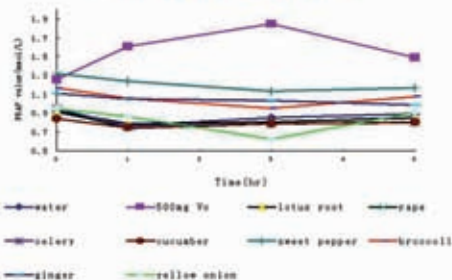
第二部分

藕、油菜和黄瓜对
老龄大鼠抗氧化功
能干预作用比较

三种蔬菜对血清抗氧化物质影响

组别	VC	VE	GSH	尿酸	多酚
	μg/ml	μg/ml	mg/L	mg/L	μg/ml
正常	4.65±1.47	32.22±9.46	0.52±0.22	6.21±2.87	39.48±6.33
藕	4.22±0.72	27.67±4.64	0.52±0.20	5.76±2.16	39.23±7.15
油菜	4.57±1.16	34.00±10.41	0.92±0.43*	5.64±2.51	38.66±4.83
黄瓜	4.12±1.35	32.87±5.61	0.77±0.35*	5.49±1.75	36.03±4.11

一次性灌胃不同抗氧化活性的蔬菜汁对老龄大鼠血清抗氧化活性的影响



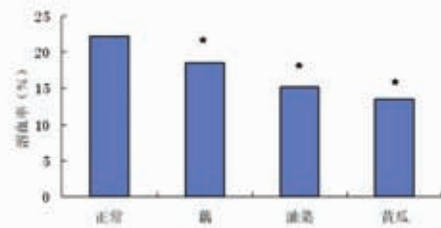
三种蔬菜对血清抗氧化功能影响

组别	FRAP	SOD	CAT	GSH-Px
	nmol/L	U	U	U
正常	0.32±0.06	69.39±9.84	2.17±1.62	3537.18±415.59
藕	0.31±0.04	73.01±8.16	1.52±1.09	3686.83±222.59
油菜	0.32±0.06	84.36±9.56*	2.19±0.96	3571.87±671.94
黄瓜	0.32±0.05	90.75±4.10*	2.01±1.03	3428.70±832.36

三种蔬菜对血清氧化产物含量影响

组别	MDA nmol/ml	OX-LDL ug/L	Carbonyls nmol/mgprotein
正常	23.16±1.57	48.30±5.46	2.91±1.74
藕	14.19±1.99*	51.82±5.42	0.90±0.58*
油菜	17.48±3.36*	55.50±5.24*	1.65±1.01*
黄瓜	17.26±5.20*	45.30±7.53	1.52±0.92*

三种蔬菜对溶血率的影响



三种蔬菜对组织MDA含量影响 (nmol/g)

组别	脾	肾	肌肉	肝	脑	心肌
正常	0.48±0.14	0.25±0.15	0.22±0.08	1.13±0.69	1.42±0.55	0.48±0.11
藕	0.49±0.14	0.15±0.05*	0.17±0.04*	1.24±0.72	1.50±0.45	0.52±0.09*
油菜	0.61±0.06	0.19±0.04*	0.21±0.09	0.77±0.30*	1.29±0.21	0.49±0.14*
黄瓜	0.66±0.06	0.15±0.05*	0.19±0.04	0.53±0.19*	1.19±0.25*	0.50±0.10*

第三部分

藕、黄瓜对老年人
抗氧化功能
干预作用比较



三种蔬菜对组织ROS水平影响 (nmol/g protein)

组别	肝	脑	心肌
正常	2.32±0.79	4.22±0.84	1.93±0.55
藕	3.64±0.91*	4.59±0.82	2.44±0.42*
油菜	1.16±0.54*	1.97±0.35*	0.80±0.44*
黄瓜	1.27±0.37*	2.46±0.58*	0.84±0.30*



清洗
榨汁
冷冻
干燥



每天1包，等于300克新鲜样品



三种蔬菜对DNA损伤的防护作用

组别	8-OH-dG ng/mgCr	彗星实验 损伤率	Tail L/Total L
正常	18.65±24.86	23.56±10.09	0.63±0.07
藕	8.15±14.29	24.99±12.21	0.55±0.09*
油菜	3.26±2.58*	28.61±13.03	0.51±0.13*
黄瓜	11.23±16.93	30.72±12.01	0.49±0.09*



蔬菜抗衰老研究
知情同意书

老年志愿者
招募



指标测定方法

- 抗氧化活性: 采用FRAP方法测定
- 主要抗氧化物质(维生素C和E、类胡萝卜素)
- 维生素C: 荧光法
- 维生素E: HPLC法
- GSH: DTNB显色法
- 尿酸: 尿酸酶法
- 总多酚: 分光光度法
- MDA水平: 采用硫代巴比妥酸法测定
- 蛋白质羰基化合物: 采用羟胺法测定
- 8-OH-dG: 采用ELISA法测定
- SOD活性: 采用黄嘌呤氧化酶法测定
- GSH-Px活性: 采用DTNB显色法测定
- CAT活性: 采用钼酸盐比色法测定
- 氧化型LDL: 采用ELISA法测定
- 红细胞溶血试验: 采用过氧化物酶法测定
- 组织自由基含量: 采用荧光探针法测定
- 淋巴细胞DNA损伤: 采用彗星(Comet)法测定



两组志愿者血浆中氧化产物含量变化的比较

组别	MDA (nmol/L)		Ox-LDL (μg/L)		Carbonyls (nmol/mg protein)	
	起点	终点	起点	终点	起点	终点
藕组	7.6±1.4	7.6±1.1	97.9±17.9	77.5±10.3	0.37±0.22	1.24±0.24
黄瓜组	7.5±1.4	6.5±1.4	135.5±208.2	141.2±201.7	1.32±0.22*	1.28±0.10

*P<0.05, 两组间比较; **P<0.01

两组老年志愿者基本情况

项目	藕组	黄瓜组
年龄	66.70±4.89	66.80±5.02
性别(男/女)	8/4	8/5
身高(m)	1.68±0.06	1.64±0.08
体重(kg)	66.75±7.79	65.96±14.38
BMI(kg/m ²)	23.74±2.23	24.36±3.67

两组志愿者淋巴细胞DNA损伤比较

组别	损伤率(%)		Tail L/Total L	
	起点	终点	起点	终点
藕组	33.66±21.66	25.52±19.92*	0.49±0.07	0.46±0.06
黄瓜组	37.10±18.34	34.10±21.03	0.57±0.04	0.51±0.05*

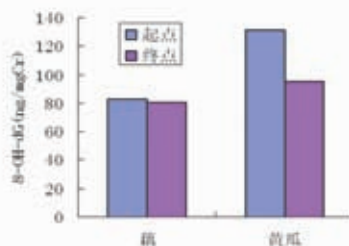
*P<0.05, 两组间比较

两组老年志愿者血浆抗氧化活性及抗氧化酶活性比较

组别	FRAP(nmol/L)		SOD(U/mL)		CAT(U/mL)		GSH-Px(U)	
	起点	终点	起点	终点	起点	终点	起点	终点
藕组	1.2±0.2	1.2±0.1	81.4±7.9	85.9±5.2	0.94±0.44	1.08±0.50	306.7±31.8	417.2±34.7*
黄瓜组	1.3±0.2	1.2±0.3	85.5±3.5	79.3±6.9*	0.77±0.23	1.05±0.63	302.6±35.5	421.8±43.3*

*P<0.05, 两组间比较; **P<0.01

两组志愿者尿中8-OH-dG含量比较

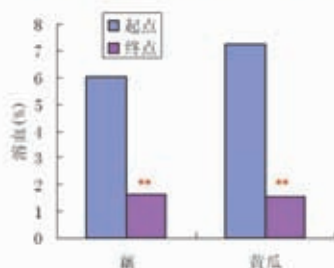


两组志愿者血浆中抗氧化物质含量变化的比较

组别	VC(μg/L)		VE(μg/L)		GSH(μg/L)		总多酚(μg/L)		尿酸(μg/L)	
	起点	终点	起点	终点	起点	终点	起点	终点	起点	终点
藕组	3.2±2.7	14.4±8.7*	15.9±3.4	15.4±4.5	21.3±13.7	45.1±14.5	33.8±10.7	61.8±6.9*	45.2±10.7	44.3±12.7
黄瓜组	8.5±1.8	14.2±7.9*	14.3±4.4	14.6±4.5	25.2±12.3	25.4±12.3	56.1±12.6	69.1±7.7*	50.6±11.1	45.6±12.9*

*P<0.05, 两组间比较

两组志愿者溶血率比较



结 论

- 不同蔬菜体外抗氧化活性差别较大，蔬菜抗氧化活性最高，带根最低。
- 蔬菜不同部分抗氧化活性也有显著差别，叶或皮部分抗氧化活性要强于茎或肉质部分。
- 一次性或七天服用并不能显著改善老龄大鼠外周血抗氧化活性。
- 四周服用三种蔬菜粉可改善老龄大鼠一些抗氧化功能，但不同抗氧化活性蔬菜之间无显著差异。
- 四周补充二种蔬菜粉可改善老年志愿者部分抗氧化功能，但二种不同抗氧化活性蔬菜之间无显著差异。

鸣
谢



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