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Abstract

Selenium (Se) is an essential trace element, plays a major part in many metabolic functions. Selenium-rich diets appear capable of protecting people against several cancers, based on its presence at active sites of glutathione peroxidase. The enzyme can protect against lipids peroxidiation-induced cell membrane damage, and reducing the potential for oxidative damage to DNA, proteins. The aim of this research was to quantify total selenium content present in foods, and antioxidant enzymes such as glutathione peroxidase (GSHPx), catalase, superoxide dismutase (SOD), and total antioxidant status in blood. The correlations between daily selenium intake and antioxidant enzymes were obtaining from healthy population. Quantitative analysis for selenium was performed using an ICP-AES (Perkin-Elmer). The antioxidants activities were measured by commercial kit (Randox Lab oratories, U.K.).

The results indicate that: (i) the daily selenium intake show no significant difference associated with GSHPx, (ii) the daily selenium intake (44 μg/day) in Taiwanese is confirm to the WHO normative requirement of 40 μg/day, (iii) the activity of GSHPx (5540 U/L) is in the normal range, but SOD (98.02 U/ml) and total antioxidant status (0.95 mmol/L) is below the normal range, (iv) the activities of catalase and total antioxidant status also correlates positively with SOD and negatively with GSHPx and (v) significant difference is found between the GPx activities and alcohol ($p<0.05$), and SOD activities correlates negatively with whether consume *Lycii Fructus*.

Key word: antioxidant enzymes, selenium, daily selenium intake

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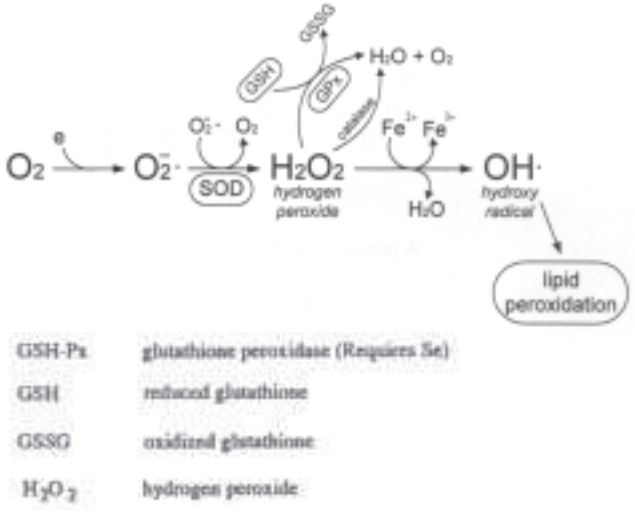

„ ˇ@ GSH ⁄ ¸ SOD ' ¥ ˝ " « ¯ Ø ⁄ ″§§@¥ ¸ ¤

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⁄@¥ b ⁄W selenoprotein-p « ƒ¡(Harrison et al., 1996)¡ AH¯Ø‹ ı ƒł†y⁄·¥ D › »Pƒ
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´·⁄ »″⁄ˇ ·« ƒ¡¤ M w¡C¶ .›„⁄ ⁄ ·ł§Q l ƒ«Æ A |ƒb‹ ı ƒł†y⁄»P GPx 'M¤ ¥L‹ ı ƒł†y
ł ¥ ƒX¡CGPx ⁄⁄¤C⁄@› »ˆfl ⁄ ⁄l§ ł ł4 › Se › ⁄l¡A¤ˆ¥H Se-cysteine "″« ƒ¡ƒs
ƒb¡Aƒ] ·ƒ ' GPx "″‹ ¡⁄ˇƒ ,ß(Clausen and Nielsen, 1988; Schukelt et al., 1991)¡A
‹ G § Œ ‰«ƒ0]fl@ ‰ ł„Lƒfiæ ⁄ _⁄§† › M ‰¶¡„Ai·›ˇƒX"«„ fl~¡B´ ¡B¤ E ¥ «"¡Aˆ
¥ ¶°⁄ ¤ ⁄¶ ¡ ¥ N ´"†«‰"⁄ ˇ ł ¸§ ¤ ‹ r'°fi ˜ł¡Cƒb ·fl ″ -ƒ A , ¥¥B″fl ß E
˜ Æ ¤ æ£‰"« ª ¤..ƒ¡⁄U¡Aƒ Uƒ „ phGPx (phospholipid-hydroperoxide glutathione peroxidase)‹ ¡'° I ł,ß¥"fl ^ ⁄ , ß¡§¥ifl ¯ ¥ phGPx ƒb⁄j¥ „«"″¥˝†z›«›n'° "
' cGPX (cellular glutathione peroxidase)¡Afl §O‹ O⁄ ¯ƒ⁄¸ AY¡A¥ifl ƒ]‹ ƒ Uƒ ″
¥˝†z« O@ ´ ⁄£ƒP¡A ›P† ¥ ‰ Ł ł„fiæ˜¶ fi¸' « ⁄£⁄@(„ Q , 1999)¡C§ Y ¥K¥Vit E
'¸§ fiæ⁄ˇ fl¥i· » fl°¥F"″ °"«' †£¥ ¥˝†z† § – flg¡"Afp¯Ø›«· »·¡B› « ¡B¤ x̂a
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(Rotruck, 1971)¡ A ¥H ·¥ifl § Œt§ fiæ⁄ˇ"″¤ ƒ ¡A¥B‹ ı ƒł†y⁄fl ¥F "″ °"«¤ †
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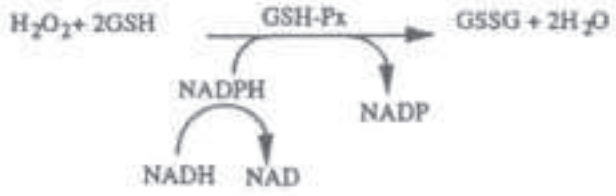
·ƒb¥˝⁄ˇ⁄ ł–"″¤ ƒ ¥] A...W[† ´·„ fiæ§ Ł‹ 'M` §˜⁄ˇ§ ¥¸
(phosphorylation)¡Aƒ]ƒ ¤ªƒł§ fiæ⁄ˇfi ˜ł¡CGPx ¥i› §C⁄jƒ h ˇ" ″ƒ† „ fiæ⁄ˇ"«¡A
‹ ƒ H_2O_2¡Aƒ glutathione(GSH)‹ O¥˝†z ⁄@"″` › fl¡A¤ § @ ¥ ¸ ƒpp„ˇ l¡Aƒ]ƒ„¡A
ƒ ⁄⁄GPx "″⁄ "R– "†Q§@‹ ·fl ¥F"″ » · «« ¡.C–



GSH-Px	glutathione peroxidase (Requires Se)
GSH	reduced glutathione
GSSG	oxidized glutathione
H_2O_2	hydrogen peroxide

„ ˇG GSH ' ¥ ˝ " « ¯ Ø ⁄ ″§§@¥ ¸ ¤

› Y " ł · ` „ ⁄ ' ⁄ j ¥ „ «"GS¶H.fi›„æ¡A•˙⁄z ›Z⁄¥§¥` ¿¯¡A¶ i ƒ ¥ifl ·£ "† ›M⁄Sfi æ ⁄ ˘ƒ(Chou, 2000)¡C

¥ ' • L ¶ q ⁄fl¥ƒb" «Ø¥Ł″ ¥ 1.‹ ¡⁄˘' § ¤ »ˆfl ⁄ ˘ ł¡2B» P ¤¥Ł‡l ˜ ∀§ ł J¥ † ƒ ¥ ¡B3.... v̄T† ›M‰ ⁄ " ″ ł q ł ź°¤ S„¥¤" ″ ¥..(Drake and Sky-Peck, 1989; Sky-Peck, 1986)¡A¥i" ‰ ' ¸¶ † ... v̄T ø⁄˘„ L{¡A‹ G „ L ¥ h · ¿ ф{¯Øflgflf⁄H ⁄″¯K¡B» ¡B N»P ·"″⁄ ¥‹»P¥ ¿ – ` H⁄(fTfuesh and Kensler, 1991; Stevens and Nerishi, 1992)¡C10$^{-7}$M "″ ·„ ¤"¢ ›MiŁHuH7 ł ƒ ł « O@‡iA"GbHuH7 † ›M ƒs‹ ¡"″„ L{⁄ ⁄ § Œ ″ t ¤″"″¤«‹»nƒ¡§G¤ † ›M› ⁄ ›¸¶k‡L † ›¥Ń"Ł¡C ·¥i¥ H ‰–– ¤ ″ § ¤ † ›M› ⁄ `"″ł ~ fi | ¡ Ł˜⁄@¥ŁD¥H†z„L thioredoxin reductase ` › thioredoxin¡A¶ ƒ § ¤ ASK 1 – °† ›M› ⁄ ` ¤ ¡C†˜⁄G› ł fi|«h‹O ·‹ ¡⁄˘Akt » "″§ ¤ † ›Mƒ″⁄ ` ¤ ¡A" ´_Caspases1 ⁄¸3 "″‹ ¡⁄˘(Tung, 1999)¡C

· "«⁄ ·"″§t¶q»P⁄ g̃[⁄ ·§t¶q"″ƒ h‡Łƒł^ ¡A‹Gfi e ' ł ¥¤Ł'ª ¥`¯ Ø″ · "″fl ¥F¡C• ·fl ° ¥fi•| › P ⁄ffl(cardiomyopathy, Keshan disease)' ¸... ₩[›P ø"″ ƒ MI' ˚(Bonomin et al., 1996)¡A⁄ Œ⁄ j† ¥¤ƒ a˘¡A¥ ' ⁄ g̃[⁄ ·§t¶q• ¥ ¡A ›P • ª⁄¯ ƒ ƒ ″ fflłe "† – ƒ†¡Vˆ •˙°^ , "″¢' M s″°¤x w⁄˘"″– w " ƒ †M‡ß¥¿ – ›H§C¡Aƒ ¥Bƒb– ₩ "″† ´·⁄¶Wfiæƒ ¥ 'M„Łfi æ˘"«• |... ₩[(Aaseth et al., 1980; Neve, 1988)¡Gƒb› f ‹ §Ł¿g¥ H ¸⁄@¨fl ¥Fƒ M †"″¶ .›„" vŁƒ ›P · ¥F"″fl ₤H ⁄⁄ ф{ L ‰¥ƒ ⁄⁄¡Bƒ †M¡B Yv¡A‹ ƒ RBC ⁄⁄GPx †£ƒ†, §C"″ ·¿ @ (‹ ø ¥¿ – ›H"″10-20 %)¡CKrsnjavi ⁄¸Beker (1990) ф{¤¯ ø– w " ƒ ⁄†M ·¿ @ ' œ ª ›§C¡A Piccinini (1996) ¥⁄H‹h ф{¤¯ ø– w " ƒ ⁄†M ·¿ @ ƒ† y•L⁄U› ¡A¥ ¤¯ ø– ₩ ¤ ¥ " ‹ , ¢ †″⁄¸»XƒbŻ Ø″⁄ ¥‹– ¡ § ¸o¡"A‹ ¥ ⁄⁄ ·"″¿ @ ƒ†› §C"″` ¶ ¡Aƒ ⁄£¤ †¸ › ₱W"″• ₦Nc(Strain et al., 1997)¡Cƒ ¥⁄~¡ A ¶ ›⁄⁄ ·"″fl ¥F⁄ ] ⊕»{ ‹ O¤¯ ø"″ƒ MIƒ] ⁄l⁄§⁄@(Garg et al., 1994)¡Cƒ °"«` › „·"″, ₦ ₹|¤ ¿EGPx "″‹ ¡' ˚(Reiter and Wendel, 1985)¡Aƒ ƒ„¡ A·"″« O@ ´ ¥D› ₦O¥]§tƒb§ fi æ˘»ˆfl glutathione ⁄⁄¡C

ƒ b ° " « ' M † › M ‹ ª ¤ s ⁄ ⁄ « ¥ X ·¥(Hocman, 1988; Ip and Lisk, 1995; Medina and Shepherd, 1980; Thompson et al.,1994)¡ A ⁄ H ^ƒ⁄†G" @« " "·»P ø fl g S Co¥˝ª†ƒ † ‹ ^(Hocman, 1988)¡C ·, ¥ R fl«¤˝ƒ†„ w ¤ ⁄ – hBˆ , ' ¡Bfl¡ B ƒ " fl e fl f Bƒ o"ˇ¡B¡ B ⁄ £ ¥ (Duvillet et al., 1998)¡C ·, fl w ^„¥Ei„ ¤ "C' ° ·fl ¥Bflg"‹¡Afp Keshan disease (Yang et al., 1989)¡C´ ‹ ª ¤ « .¥X˝ › ·IS†· " ¥´"˚"«‰Ł¤ ƒ†„ ¤ ø fl"S ¥¸¡A, g , ¯»»{P selenoamino acids " " ¥"S« ¥¸ƒ † (Clark et al., 1995,1996,1998; Ip et al., 1994)¡C

ƒb⁄ @ «¯fl¦f¤ „•‹ ª s(nested case-control study)⁄⁄¡A o† { ƒ ~ 45-68 • fiL « ´ ƒ i ⁄ Ø·‹ H Aflƒ†M ·¿ ¥« ¡ 147.2 ng/ml ¿ ' – ũÆ¯@"⁄æ†v,ßSC(OR=0.5, 95% CI=0.3-0.9)¡Fƒ †M ·¿ ¥« ¡ 147.2 ng/ml 'M130.6¡ 147.2 ng/ml „ L ¥⁄†¿{fbƒ†' •˘ " ,ß¥ ... ' •˘ƒ"†,ßSC¿ ' – ũÆ,¯@ Ø"⁄æ†v(Nomura et al., 2000)¡C⁄ S' 1990 ⁄¸ 1994 ƒ~¶ ¡ ¶ i ƒ ⁄¸¥›¥N« ª s¡A– · Q •˜q‹fiu... ⁄ ⁄·¿ @ «»P ¢ fi „‡Ifiæ ⁄˘» fl (GPx)‹ ¡' °¶¡⁄S« ^ ' ° ¡Oª{‰ fl»„¿ƒ ~ ƒ] ł«¡¥A1994 ƒ~⁄·ƒb⁄uS@"" ˜ qu¤ ƒ ... ⁄ ⁄·¿ ¥« ¡BGPx ⁄¸ıƒ †y⁄⁄ Gpx ‹ ¡' °S¡,ß⁄w ¥¸ "˝˜ quSC¡AS Y ©´ • ~ ... ¯ S|RWS[" ¥´ƒ¤¡A' ¥Hƒ ... ⁄ ⁄·¿ @ «»¥GPx "˝‹ ¡' °•|› SC¡A« ª ¤ s⁄ o †{• ƒ ... ⁄ ⁄·¿ ¥« SC' 73 ng/ml fi ¡A L ¤ " "·¥hƒXƒ¤GPx¡A« Gƒ ... ⁄⁄GPx ‹ ¡ ' °⁄]•|› S©(Nadif et al., 2001)¡C Œ⁄ " ¥«„e "˝‹ ^ ‹ ª s« ˃ ¡A¥¥ ƒ †M⁄ ⁄·⁄, fl ¿ @ «¡¥A H^¥¥¶g..˘... ¥[ƒ ˜⁄Ų¡Afb^h¥¥⁄·`⁄¸«Æ·` ·⁄,fl ¿ ¥« ⁄æ^h¥¥" ·` »P„ • † Se†{¯ ª •N",©S©(t-test, p<0.001) (Lai, 2000)¡C⁄ ƒ ~ ‰Ų "ß⁄˘(oral submucous fibrosis¡A OSF)⁄¸⁄ ƒ˜ ø–w" ¯Ø⁄""ß¥´fl E¡B¡B1¡B ·⁄¸ NS¡ƒ† S ©" †{¶H(Zhuang, 2000)¡C¥ x ˘ ¥Waƒ ˘... ·¿ @ «»¥Px† › M øo¥˝«Y"S› «¯flf¤ „ • ‹ ª s¡A« ª s¥ ¥¸NS¡‹ ¤k'°ƒ ¥¸p4841 ƒW B ««‹¤x"¢– a " 'M2501 ƒW«D– a " ¡C ‹ ª s ¶G¯ª¥ ¡AB ««‹¤x"¢– a " "˝ƒ … ·¿ ¥« †⁄SC' B ««‹¤x"¢«D– a " ¡Aƒ ¤ † "˝ƒ … ·¿ ¥« ¤ ¤Sƒ†¯ ª fi t¢S¡A¤x† M fl¤ƒ¤ "˝ƒ … ·¿ ¥« ¯ ª SC' „ • † ¡C† ¯ ¶ ⁄ "R ¶G¯ª¥ ¡A¿ ł¤x† › Mø«"„ ƒ MI'°'Mƒ … ·¿ ¥« S e ª ›t‹ ^ (Hong, 1997)¡C

1980 ƒ~‹ Œ fŒa ·' e ß•|""› „ « ~ łefl»¥¥fH ˝¤C⁄Øƒ ¥ ˜Æ¤ ¶¤q 50-200 µg (NRC, 1980)¡Afi ⁄⁄ Œ¡Bfl ^ ƒŁ˜'łM‹ Œ"˝¶...›„‰ ‹ d¯ª¥ ¡A› Y F¤¥N˙´ ¥ ¿¯¥i –o⁄@« • ⁄j"˝˜Æ¤ ¶¤q‰ ¤ 9-80 µg/day (Levander, 1986)¡ AH¯Ø ·¥ ¿¯‹O ´ ¥ › S©S¿⁄¸` ¥¥K "˝– ˇ£¶q¡A„ F S©¶q "˝˜Æ¤«¡C⁄ Œ· fia o†{ƒ¤⁄H¤k'°⁄¸ ⁄k'°¤C⁄Ø¶...›„ ·˜Æ¤ ¶¤q⁄ S©« 19 ⁄¸14 µg /day ¥i¥H„ ¤ Keshan fl(Yang et al., 1987)¡C1989 ƒ~› „ « ~ i•|¥¥B⁄ W‡z„Œ¯ ‹ • ›q¥ X·¤C⁄Ø« ˜†˜Æ¤ ¶¤q (recommended dietary allowance, RDA) (NRC, 1989)¡C¥H⁄ Œ⁄H"˝...˘› flS©Ofi ¯Ø ›«›q¥X⁄@› ƒ ¥ « ˜†˜Æ¤ ¶¤q¡A¤k⁄ ¥P⁄k⁄H ·¤C⁄Ø« ˜†˜Æ¤ ¶¤q⁄ S©« 70 ⁄¸55 µg /day (Levander, 1991)¡Af~»·⁄H ·¤C⁄Ø« ˜†˜Æ¤ ¶¤qfi ¤ ›¯Ø¥N´†vƒ A ‰ ª¡C¥@« ‰^¥˝† ´·« ˜†˜Æ¤ ¶¤qfb¤k'°⁄¸⁄k'°S¡‹ 40µg/day (WHO/FAO/IAEA, 1996)¡C

·ƒ†¥ ⁄ ««ƒ¡(-2¡B0¡B+4 'M+6)"˝fiæ⁄˘"‹˝A¡Af ` ` ˝"·œ¶q» ¥–fN+ ·´ ·«ƒ¤ L ·¡A⁄j†¡⁄ ¥H– »˜(ƒp v»˜¡B„L· »˜¡B†,»˜¡B† B†»˜)'¸UV • fig«Æ¥[⁄J

„ L fi æ ⁄ ˇ † B fi ł ⁄ ˇ ¡ A ƒ fi ł ⁄ ˇ fi ` S K ¥ [ ⁄ J ˇ Q » ˜ ¤⁄ ·S¸ƒ¤·S o' · S o ⁄ S ⁄ , fl ¡ A ⁄ @ fl ° ¥ H • L " i fi ł ⁄ ˇ ¶ i ƒ ¥ ˝ " «¸«~⁄S«e†B†z¡A (HPA, high pressure ashing)"˝S †N¶ i ƒ «†(Krushevska et al., 1996)¡C" æ ¤–¥"¸ ' ` ' ·¶ q œ¶Q"⁄ Ł " k ¥‹GA¡GHG-AAS¡HHG-ETAAS¡HICP-MS 'MHG-ICP-MS¡A ⁄ fl°ƒ ¤¥¡A« ^ ł " ‰ Y˝¶fiõœ..¸¥ »⁄" ˝·¿ @¡A G ⁄ W ⁄«e¶P«e¿ @Y¡ C ƒ ¥~¡A 1970 ƒ ~ ¥ N}¡'A« r†z ·¡B` S ⁄ˇ · ⁄ ¸ i·‹ ¶q}.'¿~⁄" ˝ ⁄ , fl¡A¥"Y˝ ¤ C ⁄ ØÆ¶œ« ~ fie¶œ« ¤ ¡A› Y ¥ üÆ¤@˝ S¸ƒ¡"˝¯K¡A« ‚ß^ł† Q ⁄ H ¯ Ø S lƒ‹ (Raptis et al., 1983)¡C MI S t"˝¶ .»„¥ ¥H„w¤ ‹ Y ¤ ·øfl¶ƒ †« ª ¤ « ¥¥Xu Æ¤œ † ⁄ S¸ƒ¡" ˝ ·⁄ƒX"«¤ ^L"k –o⁄@›P"˝ ˝G¡A·«¤¥⁄ S¸A˜ Æœ¥ ›„"« ¤ªƒ† ·S ø " ˝ƒ¤¥ (Janet R, 2001)¡C⁄H^ "˝˜ Æœ¥ D › n ©, ø¸¥"« ^ ƒ ¤ ¡A¤ ⁄⁄¤ x̄ƒ¡B ¯ƒ¡B ⁄ †£›„« "˝¿ @ , ß "¡C0.4-1.5 mg/kg Se¡A‰\^ ⁄¸¤ »s«~¡C0.1-0.8 mg/kg Se¡A⁄ "G 'M‰ › ƒ‚ƒh S0.1 mg/kg Se (WHO, 1987)¡Cƒ ›„"«⁄⁄ ·ƒ b , ¤G"˝S Ł‹¥i„F 90% (50-100%)¡A¤ ⁄⁄ · ™⁄˜¨S¸" A • | ' ¯ª¤.vS¯Ł‹† ‡v¡A¤ ƒp⁄ , fl ·· X ¤⁄£ † Q S ƒ¸B L S¸ƒ ‹h‹O · » ˜QS"Ł‹† v æ¤¨ · ›˜Qj¡Fselenoamino acids , ß L "«" ' † Q S ƒ¸ASelenomethionine "˝S Ł‹†v« 75-100¢H (Fairweather-Tait, 1992)¡C

‹ ª¤s¥ "˝

1.– ·Q¶ .»„⁄⁄ ·¿ @ ¡B¤ C ⁄ ØÆ¶œ» F ⁄⁄GPx¡BSOD¡BCAT¡BTAS ¥¡' ˚S^ «Y¡C
2.»Pƒ UC« ˜†› ¨ ¶S@@⁄æ, ß¡A" ł ¥ x̌W¶ ~¥›⁄ "˝¤ C ⁄ ØÆ¶œ OS_ƒ†⁄£¤‹ ' ¸„ L "⁄S¡S ¡C
3.¥ ' ¥ x̌W¥ «e¤^¥..ƒ†›„"«⁄⁄ ·S t¶q¡B "˝¤ C ⁄ ØÆ¶œ ¸ƒ ⁄⁄ ¢ fl ¥⁄„°fiæ ⁄˜»^fl ‹ ¡'°⁄ "R⁄S ª¯Ø« ª s¡A« ¥« ª s¥i` ¥» ŒÈ`††¶ .»„⁄^ "·˜ Æœ¶q O S_†¯ƒX¥@« ‰^¥˝† ´·⁄S† S C« ˜ ŦÆ¶œ¡C

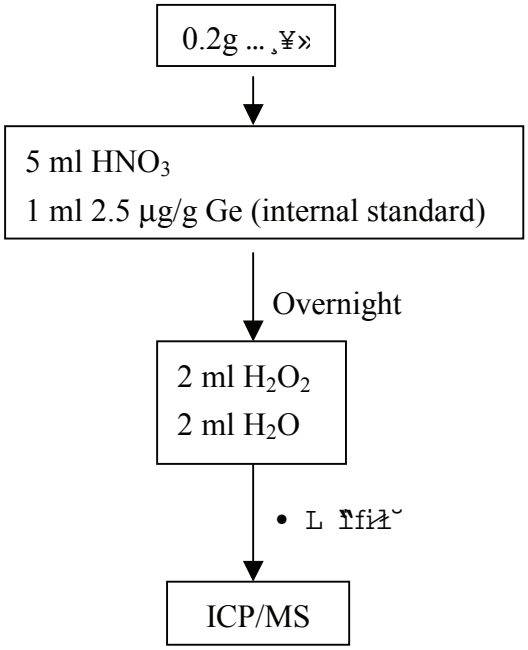
‹ ª¤s⁄Ł"k

¡]⁄@¡ ^ ›fiƒ‹¶ " B ¥w¥ ¥« ¤¥`††¶ ƒ‹ ª s‰ ‹d¡Af @p22 ƒ ¡C

¡]⁄G¡^ ¤†X‡¡G
¥H †"cƒ¡ ¤ ¶ æ g»¶ ¤ ¥», fi˜¡A¤^¶ ƒ ¶ .»„ W†v ¤ ‰ ‹d⁄¸24 ⁄pfi ¶... ›„ƒ ^ ← ¡A⁄"fie¥] A¡ƒG~ ¡ A°S O¡B¤ › "¯Ø›«¡A S°fił¶O¶q¡A'~ƒ ¤ ¡˜A L¥h 24 ⁄pfi ⁄S' ƒ†¶ .»„fił¶O˜ Æœ¶q¡A¤ «Æ¤^–N ¤ ¶G´k^ ‹ ¥⁄^ ¡B⁄ › fi ^† ¡B ƒ S†^J ¡B⁄ †£›„«~^ ¡B‰ › ^ ¡B⁄ "G^ ¡B¶..fi˜^ ⁄¸"o^ ¥¡A¤^– " ¤ ˜ Æœ¶q¡C

¡]⁄T¡^... «~` ' ·¶q⁄S⁄ "R
¡fl⁄ †£›„«~¡G H ¿ ¤œ2-3 › ¶ †¸¥«†ı⁄¸¶ fi¯¥«†ı' ⁄j‰ †ı¡ ŒH⁄¸¤ ¥ x̌W"u fi fi · ¶ ˜†‰^ ¡B¥ · ^ ⁄¸¤'^ ¥..¸¥»¡Af @p†‰^ 18 " ¡B¥ · ^ 5 " ¥H⁄¸¤'^ 6 " ¡ C¸¥»–˜¶ «Æ¤††t« Ø s' ˜ –af¡ƒ Bc⁄¡A

• ⁄ Ø e ƒ ^ „ Œ ¯ « · Š N ˜ ¡A¥H¤ «Æ˜ †B†z¡C



¸ · œ ¥ X † ‰ ^ ¡ B ¥ · ^⁄«¤Æ'A¤ œŠ¤ ' ‑¿Œ«ƒ ¥ ›Šęomętric mean¡ ^ – ¤J¤ŒŒ '·˜Æ¤œ¶qŠƒ ″ ⁄‰ƒĢ¡

¡fl ¤ ¥ L › „ ‟ « ... ¸ « ~ ¡ GN¶Š››‟«¡A¤ ⁄⁄ƒ ƒ U Œ ⁄Š„‹ Œ¤¡sA» ' ¶ƒU ″ › ‟«‹ Š ¿@« ¥ ←¡‹Š Æ–N⁄Š´k^ ‹ ¥⁄ ¡B⁄ › fi †
^ ¡Bƒ Š†Ĵ ¡B⁄ †£› ‹~^ ¡B‰ › ^ ¡B⁄ ‟G^ ¡B¶ fi ˘^ ⁄¸
‟o^ ¥¡A¤ œ ' ƒ ↛¨·‟X ƒ ¥Š¡¡C.˘

¡]¥|¡ ¤C⁄Ø ' ·˜Æ¤œ¶q⁄Šƒ ″
–N¤œ–o⁄S¥⁄^ ¡B⁄ › fi †¡Bƒ Š†Ĵ ¡B⁄ †£› ‹~^ ¡B‰ › ^ ¡B⁄ ‟G^ ¡B¶ fi ˘^ ⁄¸‟o^ ¥` ' · ¿ @ « ¡ }Xƒf^A¥›ŠĴf..Ŭ „‟‟⁄‟¶ .›„˜Æ¤œ¶ q ‰ƒ¡⁄¡A– ″ ¥X¤C ⁄Ø ' ·˜Æ¤œ¶q¡ ¥H¥D›„^ ‹ ¤ ¡A– ″ ‰ƒƒ¡ ₱U¡G

¥D›„^ › ‟«⁄Š¤C⁄Ø˜Æ¤œ¶q¡]g/day¡ ^×¥D›„^ › „ ⁄⁄ Štˋ ' · @«µg/g¡ ^
¡ ¥D›„^ › ‟«‟"¤C⁄Ø ·˜Æ¤œ¶q¡]µg/day¡ ^

– ″ ¥X¤C⁄ @j^ › ‟«⁄Š¤C⁄Ø ·˜Æ¤œ¶q¡]µg/day¡¡A¤ è''M«ÆŠY‹ ¤C⁄Ø‟"^ ' ·˜Æ¤œ ¶q¡]µg/day¡¡C

¡]⁄›¡^ƒ ⁄⁄GPx¡BSOD¡BCAT¡BTAS ¥Š fi æ » fl ≺ ₱ŠŒ'w
⁄@¡Bƒ ⁄⁄Š fiæ˘» fl GPx ‹ ¦°¡G
¤ ˘ ¥ ¸ ¥ « ,(Caflł RS 504, RANDOX)·œ–o¡Cƒ †G...¸¥»¥HŠtŠ fiƒ fl ¡]Heparin¡^, ″ ƒ‹¶ ¡A¤œ25µl ¥ ƒ ¶ ƒ , ¯ ¡C

¡ › , fl» $˘¡G

¡fl Diluting agent ¡G l † ~ ¥ ⁄ 200 ml " " ¥ h ´ ł ⁄ 2~8¢ fb J ⁄ U ¥ f 4 ¶ æ g ¡ C

¡fl Drabkin's regents ¡G l † ~ ¥ ⁄ 480 ml " " ¥ h ´ ⁄ l ⁄ A ⁄ æ ‹ l ¡ G 24 § Y ¥ i ¡ ƒ b 2~8¢ J ⁄ U ¥ f 6 ' æ ⁄ ¥ H ¡ ¡ C

¡fl Reagent ¡G l † ~ ¥ ⁄ 6.5 ml " " phosphate buffer ¡], fl 1 ¡ ¡ A f b 2~8¢ J ⁄ U ¥ i f s ' æ 48 hrs ¡ C

¡fl Cumene hydroperoxide ¡G ¤ œ 10 µl ¥ ł J 10 ml ¥ h ´ ⁄ l ⁄

¡ › ; œ GPx ‹ y { ¡ G

Heparinized whole blood 25 µl

↓ ¥ ł J 0.5 ml Diluting agent ¡ A ' æ, m 5 min

↓ ¥ ł J 0.5 ml Drabkin's regents ¡] § @ ‹ } ˜ † G ¡ A mix well

↓ ¤ œ 20 µl ƒ ¥ ⁄ @ pendorf

↓ ¥ ł J 1 ml reagent ¡ A mix well ¡ A ¥ H ⁄ fl D ⁄ Ł ƒ « 37 ¢ J " " • ¯ « " ‹ " A

↓ ¥ ł J 40 µl cumene hydroperoxide ¡ A mix well ¡] · œ ⁄ § « ƒ ¥ A [¡ A ¥ [⁄ § « ¶ • ⁄ W · œ ¡ ^

↓ ' 37¢ J ¡ B ¶ " 340 nm ⁄ U · œ † ˜ 0 ‹ ¡] A1 ¡ ^ ⁄ ¸ † ˜ 3 ⁄ ˜ ` ¡] A2 ¡ ^ " " § l œ › ¡ ¨] ¤ ¥ ¸ ¥ ^ › " ¡ ^

¡fl " ¥ , ¯ ¡ G ¤ œ 20 µl ¥ h ´ ⁄ l ⁄ ¡ ˘ 1 ml reagent ¡ ˘ 40 µl cumene hydroperoxide

¡ › › ƒ ¡ G

- blank " " ΔAblank/min ¡ (A1-A2)/3
- sample " " ΔAsample/min ¡ (A1-A2)/3
- ΔAsample/min ¡ – ΔAblank/min ¡ ΔA/min
- GPx conc. ¡ 8412 × ΔA/min × ƒ › ¿ ˘ ¡] U/L ¡ ^

– N GPx conc. (U/ml) ƒ A £ ¥ H Haemoglobin (g/ml) ¡ GPx conc. (U/g Hb)

⁄ G ¡ B ƒ ⁄ ⁄ § æ ⁄ S ⁄ D ƒ ‹ ¡ °

¤ ¥ ¸ ¥ « , fl † (Cat SD 125, RANDOX) · œ – o ¡ C ƒ † G .. ¥ » ¥ H § t § fi ƒ fl ¡] Heparin ¡ ^, " ƒ ¶ ¡ A ¤ œ 200µl ‹ ı ƒ † y ¶ ƒ, ¯ ¡ C

¡ › , fl » $ ˘ ¡ G

¡fl phosphate buffer ¡ G – N 0.1 M " " phosphate buffer ƒ 10 › ¿ ¡] 50 › sample ‹ ø » 50 ml ¡ A ¤ œ 5 ml → 50 ml ¡ ¡ C

¡fl Mixed substrate ¡ G l † ~ ¥ ⁄ 20 ml " " buffer ¡], fl 2 ¡ ¡ A f b 2~8¢ J ⁄ U ¥ f s 10 æ ⁄ ¡ C

¡fl Xanthine Oxidase ¡ G l † ~ ¥ ⁄ 10 ml " " ¥ h ´ ⁄ l ƒ b 2~8¢ J ⁄ U ¥ f 2 ' æ weeks ¡ ^

¡fl Standards ¡ G

S6 ¡ G – N Standard ¡], fl 4 ¡ ^ ¥ ł J 10 ml " " ¥ h ´ ⁄ l A mix well → 5 U/ml ¡ F

S5 ¡ G – q S6 ¤ œ 0.5 ml ƒ ¥ ⁄ @ pendorf ¡ A ¥ ł J 0.5 ml " " ¥ h ´ ⁄ l A mix well →

2.5 U/ml¡ A ¥ H ƒ ˆ„ S-l ‹¡C ¥ h ´ ⁄¡lC⁄

¡ › ;œSOD ‹ y { ¡G

¤œHeparinized RBC 250 µl¡ ¥H cold redistilled water ¥ ƒ 2 ml¡ Amix well¡ A, m ' 4¢J¡ Al 5min¡ ¥H phosphate buffer ƒ ƒ § ¤ ƒ ⁄‹ †30~60¢ ¶¡¡ Csamples ⁄ ¸ standards ‹ ƒU¤œ25 µl ƒ ¥ ŧ@ependorf¡ A¥ [⁄ J850 µl Mixed substrate¡ Amix well¡ A ¥H⁄ fl D ⁄ Ł ƒ«37¢J" " • ¯ «"¡ A¥ A[⁄ J125 µl Xanthine oxidase¡ Amix well¡]·œ⁄§ « ¢A¥ [¡ A¥ [⁄ § « Æ ¶ ¤œ¡W¶C' 37¢J¡ B ¶"505 nm ⁄U·œ† ˜30 ‹ ¡]A1¡ ^⁄ ¸† ˜210 ‹ ¡]A2¡ ^""§ l œ›¡¨]¤ ˘ ¥ ¸ ‹ ` ... ' ¸¥ ¥ i¡ ¶C

¡ ›› ƒ ¡G

¡ • Std ‡ ¡⁄

- std ""ΔA/min¡ GΔAstd/min = (A2-A1)/3
- std ""% inhibition= 100-[(ΔAstd/min×100) / (ΔAS1/min)]
- std ""% inhibition ¤œlog10¡ A' −o""›¨‹ B
- ¥H std conc.¡] ƒi...¡ ^vs.ƒU std conc.' − ƒ ¥X""B ›¨¡]` afi y.—¡ ^— " ¥X std curve ""R ›¨

¡ • Sample ‡ ¡⁄

- sample ""ΔA/min = (A2-A1)/3
- sample ""% inhibition = 100-[(ΔAsample/min×100) / (ΔAS1/min)]
- sample ""% inhibition ¤œlog10 ⁄ §Æ−a⁄ J std curve¡ A' ¤D−o""›¨ƒA›... ¥H ƒ › ¿¨¡]ƒ„‹ 100 ›¿¡ ¡ Aƒ −o¥ ƒ ""SOD conc. (U/ml)

¡ fIN¥ ƒ ""SOD conc. (U/ml)ƒA £¥H Haemoglobin (g/ml)¡ ¥ ƒ ""SOD conc. (U/g Hb)

⁄T¡ Bƒ ⁄ ⁄ § fi æ˘ ©ÆT ‹ ¦ °

−˜¥ ¸ Luck (1963)⁄§⁄Ł"k·œ−o¡ Aƒ † G ..¥¥H§t§ fiƒ fl¡]Heparin¡ ^, " ƒ ¶ ¡ A ¤œ100µl ‹ ıƒ † y ¶ƒ, ¯ ¡C

¡ › , fl» $ ˘¡G

¡ fl Potassium-phosphate buffer¡]67mM, pH7.0¡ ¡ G¤œK2HPO4¡]MW174.2¡ ^ 4.486g »P KH2PO4¡]MW136.1¡ ^5.566g •»' ¥ h ´ ⁄ l⁄⁄¡ A‰ pH ›¨ƒ 7.0¡ A' w ¶¤1L¡ Aƒ s æƒ4¢J⁄¡]¥ ¥ ƒ 900ml→‰ pH ›¨→ƒA¥ ƒ 1 L¡¡ C

¡ fl H2O2-potassium-phosphate buffer¡ G¤œ30¢H""H2O2 143µl •»' 1/15M "" potassium-phosphate buffer ⁄¡ A' ¶qƒ 100ml¡¡ C] • Ø »ts¡¡]0.04¢H H2O2 in 67mM potassium phosphate buffer, pH7.0¡ ¡]» ƒBflD¡ ^

¡ fl Chloroform-absolute ethano 40ml¡ G¤œ15ml chloroform »P 25ml absolute ethanol † ¥X

¡ › ;œCAT ⁄§...¸«~«e‡ B z‹ y { ¡G

↓¤œRBC 100µl

↓¥ ⁄J400µl ""potassium-phosphate buffer¡] ƒ< 10¢HRBC¡^
¡i↓¥ ⁄J400µl ""chloroform-ethanol¡]ƒ „ fi ` ¯Ø¿900µl¡^
↓ƒ BD15 ⁄ ˜¡ƒ„¤ B ˘ J ¥< †⁄
↓´ ⁄ 3000rpm¡A 5 ⁄ ˜`
↓¤ œ ⁄ WM†A¤ ¥H potassium-phosphate buffer ˜ 10 ›¿¡]10µl ⁄ W M†G˘
90µlpotassium-phosphate buffer¡^
↓¤œ ˜ «Æ""⁄ W M†G0 µl ¶ i ƒ U ›eatalase ⁄ § y ¤(BJ
¡]‡ l⁄§ ˜ †G» flƒ¡A¥H ¸·œ‡ J ¥¶p¡^

¡› ¸·œCAT ⁄ § y ¡{G
¡]• « 25¢J¡A«˙• ¯§Y¥i¡A⁄ƒ» • ¯--¡^
↓¥H⁄ G ƒ , ⁄ § @k„s °§@
↓¤œ sample 10µl¡A¥ ⁄J H_2O_2-potassium-phosphate buffer 990µl¡A† V^«Æ'æ¶i
spectrometer¡]240nm¡^⁄⁄·œ¡]ƒ@3 ⁄ ˜`¡A¤C15 < ""⁄ƒ@,§ l œ›¡¨^
¡fl sample ƒb¥ ⁄Jbuffer «Æ› n¤⁄W·œ
¡fl ¤ ˘ ¥ ¸ ¥›¡^AUV ¥œ·œ

¡›› ƒ ¡G
unit k/l=¡i(total assay volume)/(sample volume used)¡ƒ¡i2.3/¡ t(sec)¡ƒlog(A1/A2)
A1¡G0 < fi ""§ l œ›¨
A2¡G†˜3 ⁄ ˜`""§ l œ›¨

¥ | Bƒ⁄§ fi æ ˘»TAS < ¡°
¤ ¥¸¥ « , (Cat NX 2332, RANDOX)·œ– φCƒ †G.. ¥»¥H§t§ fiƒ fl
¡]Heparin¡^, " ƒ ¶ ¡A¤œ20µl ƒ ... ¶ ƒ , ¯ ¡C

¡› , fl» $ ˘¡G
¡fl Buffer¡G ¥¸kit † ⁄w§t¡A¤ ¥¸«e» ƒs'æƒb2~8¢J⁄⁄¡C
¡fl Chromogen¡G1 †~¥ ⁄J10 ml ""buffer¡], fl1¡¡^A¥iƒb2~8¢J⁄U¥iƒs'æ2
⁄ ¡]'¸ƒb15~25¢J⁄⁄ƒs'æ8 ⁄pfi ¡¡^C
¡fl Substrate¡G1 ml ""substrate ¥¸1.5 ml ""buffer¡], fl1¡^ ˜ ¡A¥iƒb2~8¢J
⁄U¥iƒs'æ24 ⁄pfi ¡C
¡fl Standards¡G@†~¥ ⁄J1 ml ""¥h´ ⁄l⁄ ¡A¥iƒb2~8¢J⁄U¥iƒs'æ2 ⁄¡]'¸ƒb-20¢J
⁄⁄ƒs'æ1 › ⁄°¡¡^C

¡› ¸·œTAS < y{¡G
↓¤œHeparinized plasma 20µl 'MStandards 20µl
↓¥ ⁄JChromogen 1ml¡Amix well¡A¤^⁄ flD' 37¢J
↓' 37¢J¡A" ˜Ł600nm ⁄ Uœ†˜0 < ¡]A1¡^""§ l œ›¨
↓" ‰ ƒb¥ ^›"⁄⁄¥ ⁄JSubstrate 200µl¡]·œ⁄§«eƒA¥[¡A¥[⁄§«Æ ¤⁄W·œ¡¡^A •nmix well
↓' 37¢J¡A" ˜Ł600nm ⁄ Uœ†˜3 ⁄ ˜`¡]A2¡^""§ l œ›¨

¡ fl " ¯ ¥ , ¯ 20µl¤¥eh ´ ±⁄1 ml Chromogen ¡ ˘200µl Substrate
¡ › p"¡G
TAS ¡]Total antioxidant status ¡ ˆG
Factor ¡ ¡]Standards ¿ ® ¡ ⁄ ¡]ΔA blank ¡ –ΔA standard ¡ ^
TAS ¡]mmol/l ¡ ^¡ Factor × ¡]ΔA blank ¡ –ΔA sample ¡ ^

¡]⁄»¡ ˆ B · œ ¶ q ⁄ " R§«~‰Ł" ¤
1." ¥ ⁄ "R¡G¤ C ⁄ § «:¸¶ i ƒ « e ‡ B † z fi ¡A» ¥ƒP.fi«~¡m Ÿ ˜ ¥ · œ ⁄ "R
…¸«~‹ O § _ D ¤ƒ ˆ ‹ V ¡C
2. › ‰ ˘ ⁄ "R¡G¤ C ⁄ § «:¸ƒ ⁄ ⁄@› …¸«~⁄ T «‰¡ ˘ ŸH«K ¸·œ" ºK« ¡C
3.⁄ Ł ¥ »œ• ¥ › ¡ ©œ…¸«~¥H† K ¥ ["…«~•˙ Ł ƒ '¶ q ¡A› ‰ ˘ ⁄ "R⁄Tƒ, ¡A–N⁄Tƒ ¦
– o †"G §O› ß · ⁄§… — • · fiŸƒ A .›⁄WT›¿¡A§ Y ' w , q ‹ ⁄ Łœ k ¥»¡C

¡]⁄C¡ ^† ¿›p⁄ Łk
¥H SPSS 11.5 † ¿›p† ñØ⁄ ¥ ¿ Pearson Correlation analysis ¶ ƒ ‹ ^ ' °
⁄ ¥⁄§Ap ¡ 0.05 ‹ † ¿›p⁄W„ F ª fit† §¡C

†"G»P Q‰

¡]⁄@¡ ^› fi ¥ , Œfi ˘
' ƒ ‡ – ₰ƒ~¥‹‹ O 18~31 • ‡¡ A¥ §¡ƒ ≈ ‹ 22.86 • ‡¡ A¤k' °¥ §¡‹ 21.71 • ‡¡ A ⁄k' °‹ 23.40 • ‡¡ C¤ BMI ›¨¤k' °¥ §¡‹ 22.13 ¡ A⁄k' °‹ 21.37 ¡ A¥ §¡"″BMI ›¨‹ 21.61 ¡]" ⁄@¡ ˆC

¡]⁄G¡ ^› „ ⁄⁄·§t¶ q ⁄"R
ƒ U ƒ ˆ › „« ⁄§` ' ·¿ ® ⁄ w § ₵ {" ⁄ ©⁄¡]" ⁄G¡ ˆA¤ ^¤œ¤ · ¥ ¥ §¡… §@‹ – " ¤C⁄ Ø ' ·˜ Æ¤œ¶ q¤ ¡ A¥ ˆ ¡ B⁄ › B fi†¡ B‰ › ^¡ B⁄ †£›„«~^ ¡]⁄S⁄ ‹ ‡ ‰ ¡ B ¥ · ^¡ B¤ ‡ ¡ ˆBƒ ¤ $J ˆB⁄ "G ˆ ¡ B" ô ¡ B¶..fi ˘ ^ ¡ B´ I ⁄ ^ ¿ ¥⁄'$ J¥ O¥ › §¡¿ ® ¤ §·‹ 0.33 ¡ B1.10 ¡ B0.90 ¡ B389.62 ¡ B206.54 ¡ B776.84 ¡ B37.13 ¡ B0.04 ¡ B239.66 ¡ B 0.73 ¡ B0.24 ⁄ ¿ 0.41 µg/kg ¡]" ⁄T¡ ˆC

¡]⁄T¡ ^¤ , " ¤C⁄Ø ·˜ Æ¤œ¶ q
–N¤Cƒ ¤ , " ⁄§ƒ U ƒ ˆ › „« ˜ Æ¤œ¶ q›..¥Hƒ U ƒ ˆ › „« ⁄§` ' ·¿ ® ¡ A¤ ^¥ [` ˇ⁄§«Æ § ¥o¤ , " ¤C⁄ Ø ' ·˜ Æ¤œ¶ q C ƒ ‡ –, ⁄s¥ § ¡¤C⁄Ø, ¥ƒ ˜ Æ¤œ¥ ⁄ ˆ ⁄¤ ¸ »s«~' –o ⁄§ ·˜ Æ⁄J¶ q‹ 0.028 µg/day ¡ A¥ D›„ ˆ ¡ B‰ › ^¡ B‡ ‰ ¡ B¥ · ^¡ B¤ ‡ ¡ Bƒ ¤ $J¡ B ⁄ "G ˆ ¡ B" ô ¡ B¶..fi ˘ ^ ⁄ ¿ ´ I ⁄ ^‹ ¤0.394 ¡ B5.993 ¡ B26.568 ¡ B7.90 ¡ B2.708 ¡ B0.105 ¡ B 0.007 ¡ B0.085 ¡ B0.799 ⁄ ¿ 0.002 µg/day ¡ A¤ ¥ §¡` ' ·˜ Æ¤œ¶ q«h‹ 44.489 µg/day ¡]"

¥ ¦¡^ C ƒ ' ¤ , " ⁄ § ¤ C ⁄ Ø ` ' · ˜ Æ ¤ œ ¶ q » P ¤ œ ƒ ƒ U ⁄ j ^ · ˜ Æ ¤ œ ¶ q
" G « ¥ X ¤ C ⁄ Ø ` ' · ˜ Æ ¤ œ ¶ q » P ¤ œ ƒ ‡ ‰ ^ ¡ B ¥ · ^ ¡ B ¤ ' ^ ⁄ ¸ ` ' ⁄
‹ ^ 'r=0.954¡Ar=0.890¡Ar=0.890¡Ar=0.998¡Fp¡0.05¡¡^]" ⁄ ›¡¡^A· ¤ ¥ ⁄ §A
⁄ ' ‡ ‰ ^ ¡ B ¥ · ⁄ §t ƒ ‡ ' ^ I " " · §t ¶ q A G ¤ , " ¤ C ⁄ Ø ¥ ƒ „ ›„ " « '
– o ⁄ § · Æ ¤ œ ¶ q ¤ ¥ L ^ ›„ " ⁄ h¡A' ¥ H ‹ ¥ D · § t ¶ q · ⁄ § „ " « ¤ • ‰ C
› Y ¥ » ª ¤ s ¤ , ¥ § ⁄ § C ⁄ Ø ` ' ˜ Æ ¤ œ ¶ q ¡ ^ ¤ ¥ L ‹ ^ ‹ ª ¤ s
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India¡BSouth Dakota ⁄ ¸ Venezuela § C ¥ X ‡ \ h¡C ⁄ £ „ L ƒ « ⁄ ¥ m X ¡ A · ˜ Æ ¤ œ ¶ q
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› ¨ ¡]4171~10881 U/L¡ ^ § ⁄ " ¡Af SOD ⁄ ¸ TAS ⁄ § ‹ ¡ ' ° ‹ § ¢ { § C " ‹ p ¡ A ⁄ ¥ H SOD
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^ ¡]r=0.249¡Ar=0.089¡Ar=0.115¡ ^ Af »P TAS § ¢ { › t ‹ ^ ¡ r ‡ =-0.363¡ ^ Af ‡ £ L ¯ ª
‹ ^ " ¡] ⁄ E ⁄ „ ⁄ T ¡ ^ C ƒ ', ¤ ˜ Æ ¤ œ ⁄ † £ ƒ › „ « ~ o ⁄ § · ˜ Æ ¶ q A ⁄ £ ‰ ‹ O ‡ ‰ ^ ¡ B
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‹ ¡ G ¶ ... s » P ¯ Ø " GPx ¶ q « h § ¢ { ¯ ª ¥ ¿ ‹ ^ ¡ r ‡ =0.457¡Ap¡0.05¡ ^ Af ‹ § ß " " ~ Æ œ
» P § _ ¥ 'M ¯ Ø " SOD ¶ q § ¢ { ¯ ª › t ‹ ^ ¡ r ‡ =-0.432¡Ap¡0.05¡ ^]" ⁄ E ¡ ^ C

摘要

1. 本研究調查台灣地區一般民眾硒攝取量，並探討硒攝取量與血液中硒濃度及抗氧化酵素活性之關係。
2. 本研究結果顯示台灣地區一般民眾硒攝取量為44 μg/day，與其他國家相較為偏低。
3. 本研究結果顯示血液中硒濃度與硒攝取量呈顯著正相關，而與血液中GPx及SOD活性無顯著相關。
4. 本研究結果顯示血液中GPx活性與硒攝取量呈顯著正相關（r=0.457，p< 0.05），而血液中SOD活性與硒攝取量呈顯著負相關（r=-0.432，p< 0.05）。

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	Age (years)			BMI (kg/m2)		
	Total (n=22)	Male (n=7)	Female (n=15)	Total (n=22)	Male (n=7)	Female (n=15)
Mean	22.86	21.71	23.40	21.61	22.13	21.37
SD	4.11	2.56	4.64	2.94	2.27	3.25
Range	18-31	19-26	18-31	17.94-30.22	20.11-26.53	17.94-30.22

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Sample		Se (µg/kg)	Country	Reference
Milk and cheese	whole	0.15	UK	Barclay et al., 1995
	skim	0.1		
	Brie	0.36		
	Camembert	0.68		
	Cheddar	0.74		
	Cheddar	1.1		
	Cottage	0.37		
	Cottage	0.41		
	Cream	0.35		
	Danish Blue	0.64		
	Edam	0.64		
	Feta	0.5		
	Fromage Frais	0.22		
	Fromage Frais	0.19		

	Gouda	0.8		
	Parmesan	1.1		
	Processed cheese	0.67		
	Spread	0.25		
	Spread	0.38		
	Stilton	0.8		
	full fat	0.14		
	low fat	0.15		
	imitation (full fat)	0.11		
	(low fat)	0.1		
	(very low fat)	0.15		
	luxury	0.17		
	Total Mean	**0.43346**		
	Total GM	**0.33215**		

Sample		Se (µg/kg)	Country	Reference
Cereals	Rice	52.3	India	Roychowdhury et al., 2003
	Wheat	157		
	Lentil	223		
	Pulse, others	484		
	Rice	66.2	India	Roychowdhury et al., 2003
	Wheat	218		
	Lentil	272		
	Pulse, others	168		
	barley	0.13	UK	Barclay et al., 1995
	cornflour	0.04		
	rye flour	0.25		
	sago	0.01		
	tapioca	0.03		
	white	0.48		
	wholewheat	0.55		
	brown	1		
	long grain	1.3		
	wheat flour-brown	0.44		
	wheat flour-white	0.23		
	wheat flour-strong white	0.25		

	wheat flour-wholemeal	0.59		
	brown bread	0.48		
	currant bread	0.35		
	granary bread	0.39		
	Hovis (wheatgerm) bread	0.49		
	white-unsliced bread	0.44		
	white-sliced bread	0.43		
	French stick	0.45		
	weetabix	0.23	UK	Barclay et al., 1995
	oatmeal	0.31		
	cornflakes	0.47		
	museli	0.42		
	shredded wheat	0.31		
	oat flake	0.2		
	bran based	0.36		
	added sugar	0.22		
	rice based	0.17		
	Total Mean	**44.63568**		
	Total GM	**1.102914**		

Sample		Se (µg/kg)	Country	Reference
Vegetables	Potato-flesh	0.28	India	Roychowdhury et al., 2003
	Potato-skin	1.64		
	Onion	5.2		
	Garlic	4.8		
	Green Chili	6.16		
	Arum leaf	0.2		
	Beans	8.36		
	Spinach	0.2		
	Leaf of vegetables	0.72		
	Radish	6		
	Green Banana	3.68		
	Papaya (with peel)	0.2		
	Brinjal	7.28	India	Roychowdhury et al., 2003

	Turmeric, green	1.92		
	Potato-flesh	1.76		
	Potato-skin	4.32		
	Onion	11		
	Garlic	10		
	Green Chili	4.72		
	Beans	6.2		
	Leaf of vegetables	6.44		
	potatoes	0.16	UK	Barclay et al., 1995
	peas fresh	0.02		
	peas dried	0.3		
	peas-canned	0.04		
	peas-canned, processed	0.19		
	peas-frozen	0.03		
	beansprouts	0.14		
	beans-broad	0.06		
	beans-butter	1.1		
	beans-French	0.03		
	hummus	3.5		
	Total Mean	3.020313		
	Total GM	0.900635		

Sample		Se (μg/kg)	Country	Reference
Fish	Salmo salar Linnaeus	2010	Taiwan	Chien et al., 2003
	Scomberomorus commersoni	1750		
	Sebastiscus albofasciatus	1550		
	Eleutheronma tetradactylum Show	1550		
	Liza macrolepis	1550		
	Lateolabrax japonicus Cuvier	1540		
	Acanthopagrus latus	1510		
	Theragra chalcogramma	1390		

	Psenopsis anomale Temminck and Schlegel	1360		
	Plecoglossus altirelis Temminck and Schlegel	1350		
	Oncorhynchus mykiss	1350		
	Oreochromis sp.	1340		
	Larimichthys polyactis	1340		
	Taius tumifrons	1330		
	Priacanthus macranthus Cuvier	1310		
	Trichiuruslepturus	1200		
	Epinephelus mystacinus	1170		
	Mola mola Linnaeus	810		
	Total Mean	1411.6667		
	Total GM	1389.6207		

Sample		Se (μg/kg)	Country	Reference
Crustaceans	Panulirus longipes	1300	Taiwan	Chien et al., 2003
	Ovalipes punctatus	1280		
	Metapenaeus ensis	1270		
	Aristeus viritis	1110		
	Portunus sanguinolentus	1090		
	Total Mean	1210		
	Total GM	1206.5388		

Sample		Se (μg/kg)	Country	Reference
Bivalve molluscs	Crassostrea gigas	1180	Taiwan	Chien et al., 2003
	Raphia amabilis	1330		
	Ruditapes variegates	870		
	Meretrix lusoria	730		
	Amusium pleuronectes	630		

	Haliotis diversicoloraquatilis Reeve	350		
	Total Mean	848.3333		
	Total GM	776.8385		

Sample		Se (µg/kg)	Country	Reference
meat	beef	0.76	UK	Barclay et al., 1995
	pork	1.4		
	lamb	0.38		
	white meat	1		
	dark meat	1.5		
	duck	2.2		
	pheasant	1.4		
	grouse	2		
	venison	0.89		
	chicken breast	73	Spain	Díaz-Alarcón et al., 1996
	veal	45		
	lamb	28		
	pork chop	81		
	pork chine	383		
	rabbit	90		
	veal	20	U.S.A	Moxon et al., 1980
	lamb	50		
	pork chop	40		
	chicken breast	160	Canada	Arthur, 1982
	veal	20		
	pork chop	300		
	chicken breast	200		
	veal	10		
	lamb	50		
	pork chop	60		
	veal	290	U.S.A	Olson and Palmer, 1984
	lamb	310		
	pork chop	310		
	chicken breast	160	Spain	Díaz-Alarcón et al., 1996

	veal	80		
	lamb	40		
	pork chop	40		
	rabbit	30		
	chicken breast	54	France	Simonoff and Simonoff, 1983
	veal	80		
	lamb	67		
	pork chop	107		
	rabbit	167		
	veal	165	Russia	Golubkina and Khotimchencko, 1994
	pork chop	129		
	chorizo	355	Spain	Díaz-Alarcón et al., 1996
	sausage	128		
	ham	87		
	chopped	87		
	mortadella	71		
	cured ham	179		
	Total Mean	99.07674		
	Total GM	37.13453		

Sample		Se (µg/kg)	Country	Reference
Selected fruits		0.04	UK	Barclay et al., 1995

Sample		Se (µg/kg)	Country	Reference
Oil	peanut	313	Italy	Dugo et al., 2003
	soybean	458		
	sunflower	225		
	rice	99.5		
	corn	332		
	grapestone	144		
	seeds	296		
	Total Mean	266.78571		
	Total GM	239.6631		

Sample		Se (µg/kg)	Country	Reference
Nuts	almonds	0.15	UK	Barclay et al., 1995
	brazils	25.4		

	cashew	2.7		
	coconut	0.65		
	hazelnut	0.2		
	macademia	0.66		
	walnut	0.31		
	Total Mean	4.295714		
	Total GM	0.830981		

Sample		Se (µg/kg)	Country	Reference
Beverages	tea	0.59	UK	Barclay et al., 1995
	coffee	0.87		
	Total Mean	0.73		

Sample		Se (µg/kg)	Country	Reference
Savoury snacks	potato based	0.11	UK	Barclay et al., 1995
	maize based	0.33		
	wheat based	0.36		
	Total Mean	0.266667		
	Total GM	0.235543		

Sample	Se (µg/kg)	Country	Reference
Chocolate	0.41	UK	Barclay et al., 1995

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Sample		Se (µg/kg)
milk and cheese	Total Mean	0.43
	Total GM	0.33
Cereals	Total Mean	44.64
	Total GM	1.10
Vegetables	Total Mean	3.02
	Total GM	0.90

Fish	Total Mean	1411.67
	Total GM	1389.62
Crustaceans	Total Mean	1210.00
	Total GM	1206.54
Bivalve molluscs	Total Mean	848.33
	Total GM	776.84
meat	Total Mean	99.08
	Total GM	37.13
Selected fruits		0.04
Oil	Total Mean	266.79
	Total GM	239.66
Nuts	Total Mean	4.30
	Total GM	0.83
Beverages	Total Mean	0.73
Savoury snacks	Total Mean	0.27
	Total GM	0.24
Chocolate		0.41

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‰ ¸„ ' §O		¥ ˆ Se intake (µg/d)	¥ D„ˆ Se intake (µg/d)	ƒ §‡J ˆ Se intake (µg/d)	‡‰ˆ Se intake (µg/d)	¥ · ˆ Se intake (µg/d)	¤'ˆ Se intake (µg/d)	‰ › ˆ Se intake (µg/d)	⁄ "Gˆ Se intake (µg/d)	¶ fi˘ˆ Se intake (µg/d)	"oSe intake (µg/d)	¥ ' §⁄O´ Ł Se intake (µg/d)	Ł Se intake (µg/d)	Total Se intake (µg/d)
1	¤k	0	0.416	7.838	0	0	0	0.118	0.017	0	0	0	0	8.389
2	¤k	0	0.311	5.570	0	0	0	0	0	0	1.198	0	0	7.079
3	¤k	0	0.583	0.743	48.637	60.327	31.540	0.023	0	0	7.190	0	0	149.041
4	¤k	0	0.319	5.941	34.741	0	0	0	0	0	1.198	0	0	42.199
5	¤k	0	0.209	3.342	0	0	0	0.207	0.015	0	0	0	0	3.773
6	¤k	0.165	0.468	3.713	31.266	0	0	0.119	0.024	0	1.198	0	0	36.953
7	¤k	0	0.550	2.599	0	0	0	0.009	0	0	0	0	0	3.158
8	⁄k	0	0.234	16.857	0	0	0	0.169	0.012	0.511	0	0	0	17.783
9	⁄k	0	0.077	6.126	0	0	0	0.397	0.012	0	0	0	0	6.613
10	⁄k	0.083	0.435	10.749	76.429	0	0	0.061	0.025	0.402	0	0	0	88.182
11	⁄k	0	0.082	1.559	145.910	0	0	0.104	0	0.256	0	0.004	0.001	147.916
12	⁄k	0	0.253	9.431	0	0	0	0.072	0	0	0	0	0	9.756
13	⁄k	0	0.252	5.384	0	0	0	0.009	0	0	0	0	0.001	5.646
14	⁄k	0.007	0.462	3.899	0	0	10.565	0.117	0.014	0	0	0	0	15.063
15	⁄k	0.079	0.165	5.112	4.169	0	0	0	0	0.256	0	0	0	9.780
16	⁄k	0.059	0.308	13.552	0	0	0	0.122	0.003	0	0	0	0	14.044

17	㎞	0	0.187	0.854	0	0	0	0.014	0	0	0	0.045	0	1.100
18	㎞	0.099	0.270	14.221	0	0	0	0.297	0.014	0.029	5.992	0	0.002	20.923
19	㎞	0.090	0.303	2.970	0	0	0	0.054	0	0.329	0	0	0	3.745
20	㎞	0	0.113	2.228	216.781	105.572	0	0.153	0.004	0	0	0	0	324.850
21	㎞	0.015	0.187	3.156	0	0	14.760	0.154	0.006	0	0	0	0	18.278
Total Mean		0.028	0.294	5.993	26.568	7.900	2.708	0.105	0.007	0.085	0.799	0.002	0.000	44.489

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	Se intake from Fish (µg/day) ¡]r ¡ ^	Se intake from Crustaceans Crustaceans (µg/day) ¡]r ¡ ^	Se intake from Bivalve mollusks (µg/day) ¡]r ¡ ^	Se intake from Total seafood (µg/day) ¡]r ¡ ^
sex	0.131	0.068	-0.020	--
Total Se intake (µg/day)	0.954*	0.890*	0.890*	0.998*

* ¡ Ɋp ¡ 0.05

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Country	Daily selenium intake (µg/day)	Reference
Canada	98-224	Gissel-Nielsen, 1998
USA	60-150	Oster and Prellwitz, 1989
China	11-116	Yang et al., 1983,1988
Greece	110	Bratakos and Ioannou, 1991
Finland	90	Varo, 1993
Netherlands	72	Van Dokkum et al., 1989
Mexico	60.6-72.9	Valentine etr al., 1994
Japan	69	Suzuki et al., 2001
India	61.9	Mahapatra et al., 2001
Belgium	28.4-61.1	Robberecjt amd Deelstra, 1994
France	48	Pelus et al., 1994
Germany	38-48	Oster and Prellwitz, 1989
Sweden	44	Beker and Kumpulainen, 1991
Italy	43	Allegrini et al., 1985
UK	29-39	MAFF, 1997; Church et al, 1998
Portugal	37	Reis et al., 1990
Spain	35	Díaz-Alarcón et al., 1996
England	35	Brown et al., 2000
New Zealand	29	Duffield et al., 1999
Hungary	41-90	Alfthan et al., 1992

South Dakota	68-444	Swanson et al., 1990
Venezuela	200-350	Combs and Combs, 1986
Mexica	61-73	Valentine et al., 1994
Taiwan	44	This study

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‰ ₴„	' °§O	GPx conc. (U/L)	SOD conc. (U/ml)	TAS conc. (mmol/L)	CAT conc. (unit)
1	¤k	5047	107.42	1.152	15.897
2	¤k	6393	166.91	0.933	30.442
3	¤k	6393	82.02	0.954	3.467
4	¤k	5159	143.19	0.871	7.272
5	¤k	4935	107.42	1.116	9.646
6	¤k	4711	134.73	1.100	0.001
7	¤k	5159	82.02	1.074	8.767
8	⁄k	9646	97.58	1.033	6.227
9	⁄k	5720	151.36	1.121	10.204
10	⁄k	5271	134.73	1.022	25.676
11	⁄k	6842	174.33	0.829	21.669
12	⁄k	4935	92.50	1.090	11.850
13	⁄k	4711	116.87	1.001	21.384
14	⁄k	5272	112.19	1.043	32.863
15	⁄k	5383	82.02	0.996	13.090
16	⁄k	4711	112.19	0.954	46.269
17	⁄k	5047	47.54	0.730	7.463
18	⁄k	5832	47.54	0.819	30.170
19	⁄k	5047	87.32	0.887	22.059
20	⁄k	6169	92.50	0.819	27.321
21	⁄k	5720	76.61	0.860	9.633

22 ⁄k	5496	47.54	0.652	14.367
Total GM	5540	98.02	0.947	9.528
SD	1078	36.02	0.135	11.457
Normal range[ifl]	4171-10881	164-240	1.30-1.77	¡—

[ifl]¡Gnormal range ƒ'RANDOX ⁄ ‰ ¥ q ' · ß ⁄§,Œfi˘

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	GPx conc. (U/L)	SOD conc. (U/ml)	TAS conc. (mmol/L)	CAT conc. (unit)
GPx conc. (U/L)	¡—		-0.103	-0.128
SOD conc. (U/ml)		¡—	0.397	0.144
TAS conc. (mmol/L)	-0.103	0.397	¡—	-0.168
CAT conc. (unit)	-0.128	0.144	-0.168	¡—

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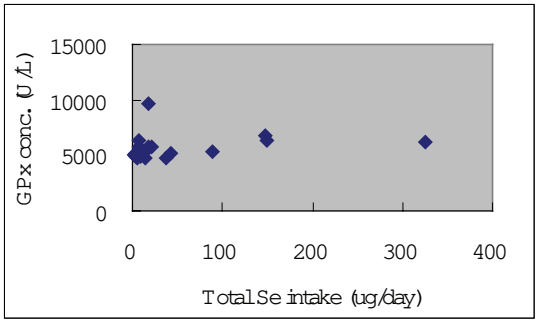
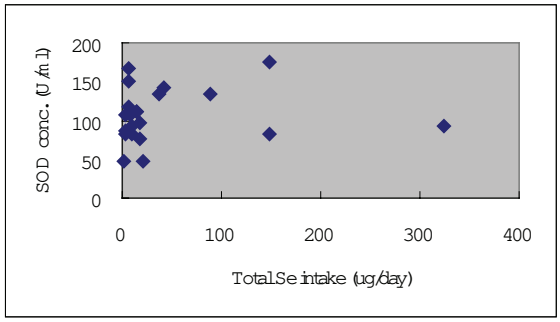
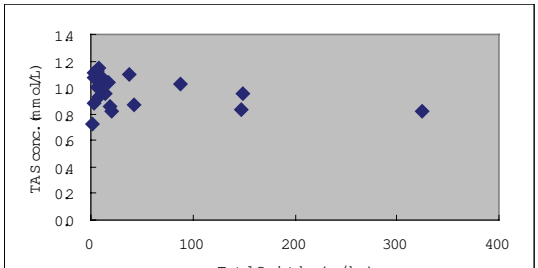
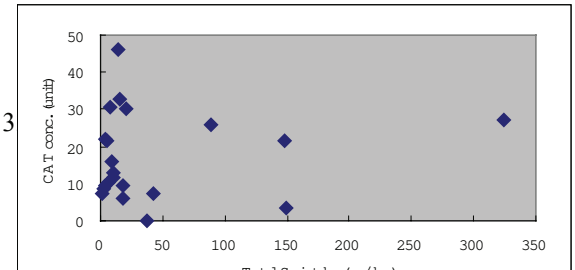
	GPx conc. (U/L)	SOD conc. (U/ml)	TAS conc. (mmol/L)	CAT conc. (unit)
sex	0.081	-0.258	-0.370	0.384
Total Se intake (µg/day)	0.249	0.089	-0.363	0.115
Se intake from fish (µg/day)	0.209	0.245	-0.372	0.145

Se intake from Crustaceans Crustaceans (μg/day)	0.154	-0.140	-0.294	0.120
Se intake from Bivalve mollusks (μg/day)	0.181	-0.170	-0.276	0.039
Se intake from Total seafood (μg/day)	0.222	0.098	-.365	0.096
Coffee	0.306	0.010	0.033	-0.310
Drinking	0.457*	-0.003	0.245	-0.239
Smoking	0.047	-0.201	0.136	-0.310
< ß	-0.121	-0.432*	-0.152	0.164
< ı·	-0.086	-0.218	-0.050	0.136
⁄ Hx	-0.032	-0.121	-0.103	-0.161
i ,¥R fl	-0.307	0.066	-0.081	-0.047

*¡Gp¡ 0.05