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7.37  
. / 2.7-1.5

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2.58 - 1.76

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# Determination of Fluoride in Five Tea Samples and Some Infusions Using Spectrophotometric Method

**Malak Al Joubbeh**

Department of Chemistry-Faculty of Sciences-Damascus University

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## ABSTRACT

Four different brands of black tea and one brand of green tea commonly available in Syrian markets were tested to measure the level of fluoride contained in their liquid using four different methods of infusion and utilizing the spectrophotometer technology: A. Infusion without boiling. B. Infusion with boiling. C. Repeated infusion. D. Continuous infusion.

The results have indicated that the average level of fluoride in the samples of black tea liquid is higher than the one in the green tea sample regardless of the infusion method used. Also, it was found that the level of fluoride released from all samples is higher when boiling them in water from 1 to 5 minutes. In addition, it was proved that the level of fluoride in tea liquids is higher when it's prepared using repeated infusion, but it's lower when the tea has been prepared using the continuous infusion method. Tea brands (2) and (4) released the highest level of fluoride 7.37mg/L and 5.01mg/L respectively, which are very high levels comparing to the other brands which released between 1.5mg/L to 2.7mg/L. To prevent fluoride from reaching poisoning levels, the total daily consumption of black tea liquid of brands (2) and (4) should not exceed 1.76L and 2.58L respectively and to avoid preparing them using the repeated and continuous infusion methods.

**Key words:** Tea, Fluoride, Spectrophotometer, Infusion .

Graham,1983 2000 )  
(1995 1999

(E G C G) epigallocatechingallate  
(Bushman.J.L;1998)

(Maxium Contaminant level) MCL

Meiers, 1984; Waldbott,1978; Srebnik-  
Who,1970; Who,1984; Sha and ) (Friszman,1976  
; Zheng,1993;sha and zheng,1994; Lin,1994; Rüh,1968;  
(1994 (21)

15 (Srebnik-Friszman,et al,1976)  
. ppm 125 50  
(Nabrzyski and Gajewsk,1995)  
16 ppm 340  
(Dabeka and Mckenzie,1995 )  
/ 4.57  
(Tokalio ,et al, 2004)  
. / 0.64-3.55

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( Jenkins,1991; Opinya et al,1991; Diouf et al,1994 )

. / 5.8-9

(Gulati, et al, 1993)

/ 1.55-3.21

. / 0.3-0.9

(Fung, et al ;1999)

1.60

/ 1.89

. /

(wei. 1989)

479

. 1.05

/ 0.7

(Levy,1994)

1

(Who, 1984)

1.5-4

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.(5)

(Arnold and Lenore, 1992) SPADNS

Zr F<sub>6</sub><sup>-</sup>

|       |    |     |   |                   |
|-------|----|-----|---|-------------------|
|       |    |     | : | -A                |
| (DDW) |    | 100 |   | 1                 |
|       | :  |     |   | 100               |
|       | .( | 9   | ) | -                 |
|       |    |     | : | - B               |
| 100   |    | 100 |   | 1                 |
|       | :  |     |   | -                 |
|       | .( |     | ) | -                 |
|       |    |     | : | - C               |
|       | 1  |     |   | 100               |
| 92 89 |    |     |   |                   |
|       |    |     | : | - D               |
|       | 1  | 100 |   |                   |
|       |    |     |   | (360,120,60,30,5) |
| 92 89 |    |     |   |                   |

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Spectrophotometer JASCO 7800/U.V/ Vis

. ( / 10)  
0.958 ) SPADNS  
(ZrOCl<sub>2</sub>.8H<sub>2</sub>O) . ( 500 DDW  
130 :  
350 DDW 25  
. 500 DDW HCl  
:  
/ SPADNS  
100 SPADNS 10 :  
. 10 HCl 7 DDW  
. SPADNS

5 / 0.01-1 :  
50 / 10  
570 5

.(Arnold and Lenores,1992) 0.2224

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( 100/ 1)

(1 1 )

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( / ) (1)

( ) ( )

|       |       | 9     | 8     | 6     | 4     | 2     | ( ) |
|-------|-------|-------|-------|-------|-------|-------|-----|
| 1.487 | 0.165 | 1.626 | 1.623 | 1.581 | 1.406 | 1.200 | 1   |
| 2.773 | 0.255 | 2.970 | 2.992 | 2.977 | 2.512 | 2.415 | 2   |
| 0.927 | 0.317 | 1.140 | 1.125 | 0.982 | 0.960 | 0.427 | 3   |
| 2.131 | 0.204 | 2.298 | 2.310 | 2.277 | 1.935 | 1.833 | 4   |
| 0.850 | 0.147 | 0.948 | 0.951 | 0.936 | 0.849 | 0.566 | 5   |

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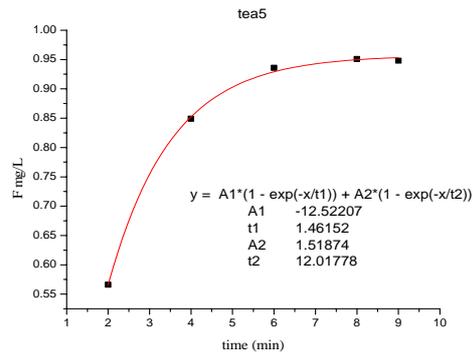
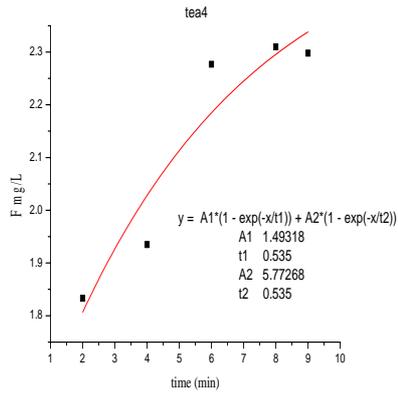
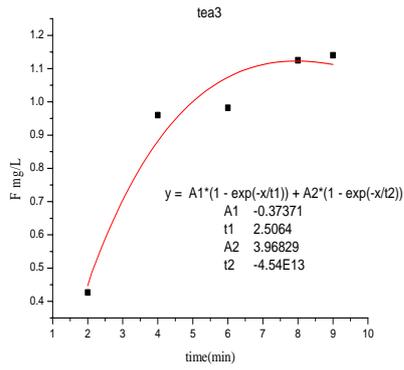
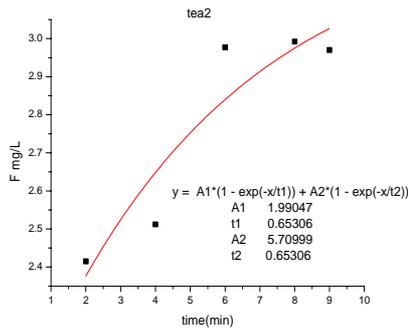
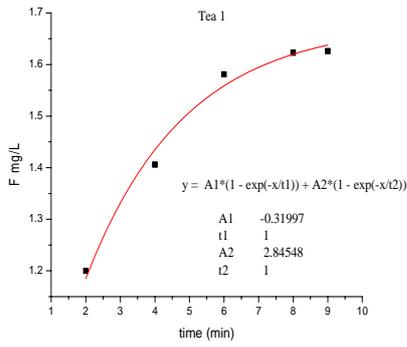
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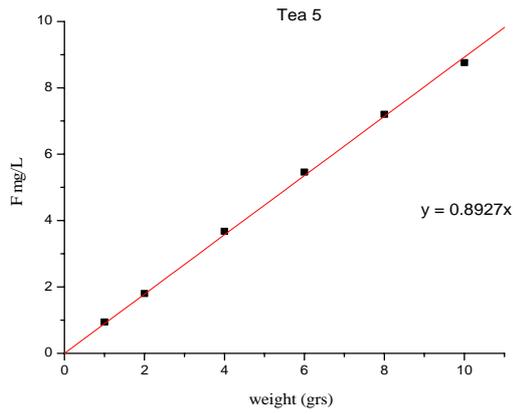
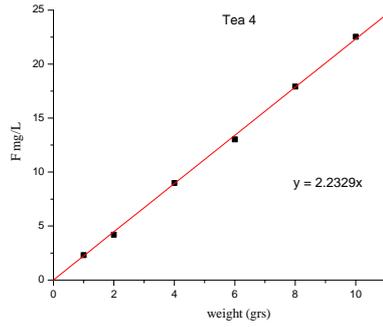
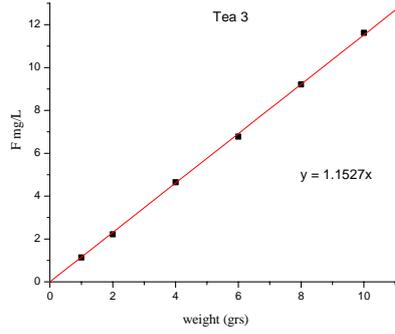
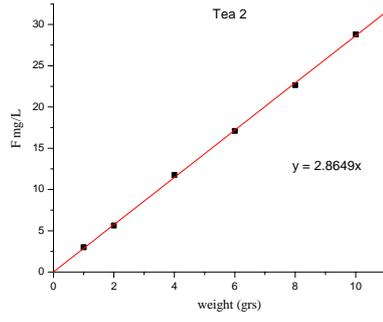
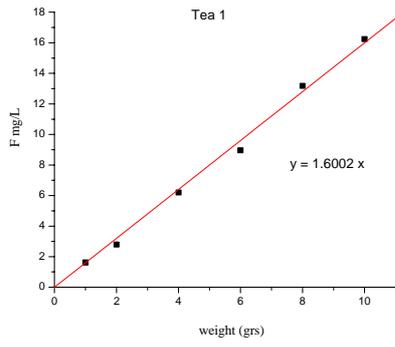
( / ) (2)

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| /      |       | 10     | 8      | 6      | 4      | 2     | 1     | ( ) |
|--------|-------|--------|--------|--------|--------|-------|-------|-----|
| 8.167  | 5.267 | 16.240 | 13.180 | 8.960  | 6.200  | 2.800 | 1.620 | 1   |
| 14.825 | 9.087 | 28.800 | 22.650 | 17.100 | 11.775 | 5.625 | 3.000 | 2   |
| 5.937  | 3.701 | 11.620 | 9.210  | 6.780  | 4.650  | 2.220 | 1.140 | 3   |
| 11.495 | 7.179 | 22.527 | 17.919 | 13.029 | 8.988  | 4.266 | 2.304 | 4   |
| 4.642  | 2.795 | 8.762  | 7.205  | 5.460  | 3.678  | 1.801 | 0.946 | 5   |



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( / )  
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(2)

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( 100/ ) :

(3) (3)

( / ) (3)  
( )

|       |       | 5     | 4     | 3     | 2     | 1     | ( ) _____ |
|-------|-------|-------|-------|-------|-------|-------|-----------|
| 2.476 | 0.343 | 2.660 | 2.660 | 2.650 | 2.620 | 1.790 | 1         |
| 3.731 | 0.334 | 3.950 | 3.925 | 3.900 | 3.810 | 3.070 | 2         |
| 1.236 | 0.090 | 1.350 | 1.320 | 1.230 | 1.170 | 1.110 | 3         |
| 3.104 | 0.337 | 3.304 | 3.292 | 3.276 | 3.216 | 2.432 | 4         |
| 0.952 | 0.043 | 0.989 | 0.987 | 0.972 | 0.936 | 0.876 | 5         |

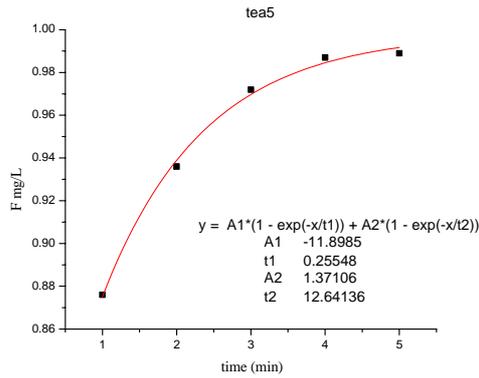
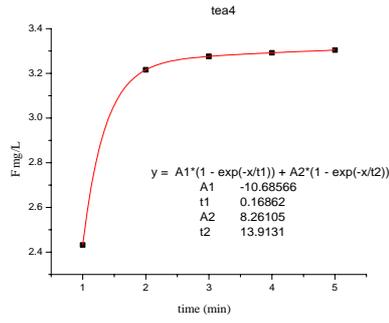
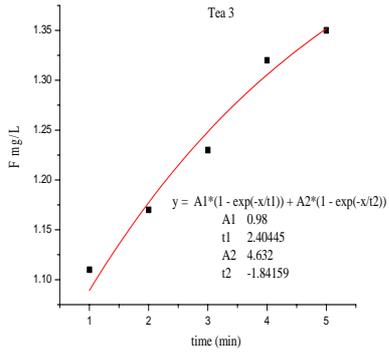
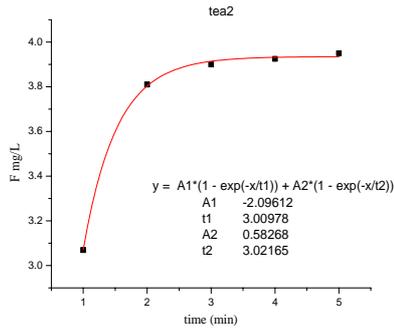
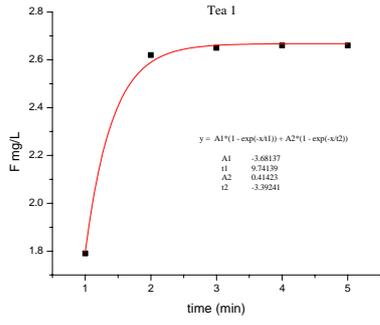
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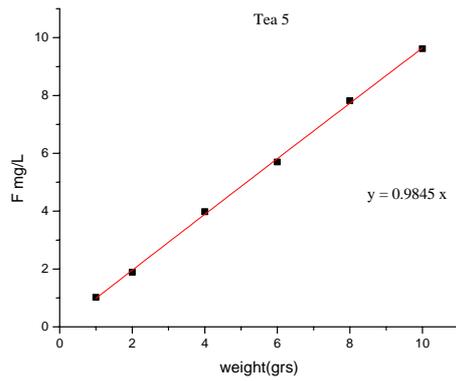
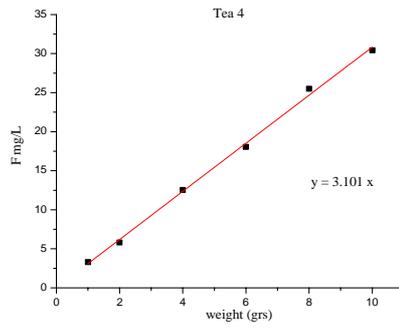
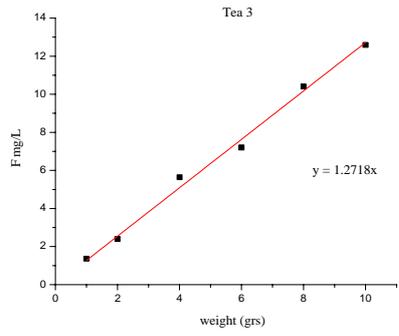
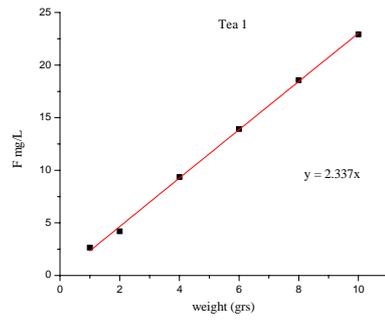
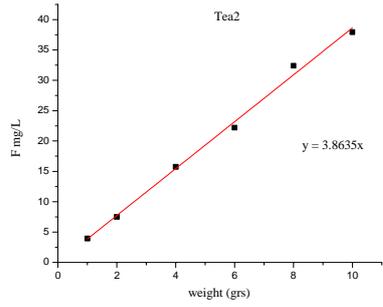
.(4 4 )

( / ) (4)  
( )

| /      |        | 10     | 8      | 6      | 4      | 2     | 1     | ( ) _____ |
|--------|--------|--------|--------|--------|--------|-------|-------|-----------|
| 11.938 | 7.408  | 22.92  | 18.576 | 13.920 | 9.360  | 4.200 | 2.652 | 1         |
| 19.956 | 12.336 | 37.950 | 32.400 | 22.200 | 15.750 | 7.500 | 3.937 | 2         |
| 6.599  | 4.006  | 12.589 | 10.406 | 7.205  | 5.638  | 2.397 | 1.360 | 3         |
| 15.940 | 9.826  | 30.420 | 25.500 | 18.060 | 12.540 | 5.820 | 3.300 | 4         |
| 5.013  | 3.053  | 9.620  | 7.820  | 5.700  | 3.980  | 1.890 | 1.020 | 5         |



( / ) (3)  
 . ( )



( / ) (4)  
 ( )

1 ( ) : -3

(5 5 ) .  
( / ) (5)

|       |       | 5     | 4     | 3     | 2     | 1     | _____ |
|-------|-------|-------|-------|-------|-------|-------|-------|
| 3.050 | 0.189 | 0.401 | 0.457 | 0.555 | 0.715 | 0.923 | 1     |
| 7.053 | 0.819 | 0.473 | 0.600 | 1.290 | 2.180 | 2.510 | 2     |
| 3.075 | 0.319 | 0.272 | 0.315 | 0.545 | 0.822 | 1.120 | 3     |
| 5.04  | 0.499 | 0.438 | 0.528 | 0.921 | 1.440 | 1.713 | 4     |
| 1.67  | 0.326 | 0.138 | 0.146 | 0.157 | 0.248 | 0.982 | 5     |

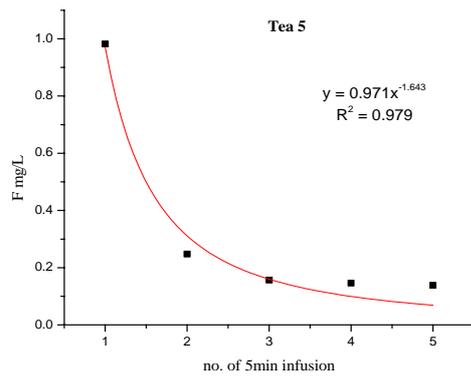
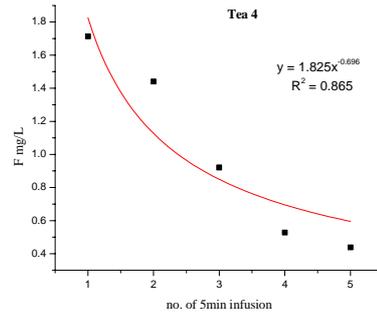
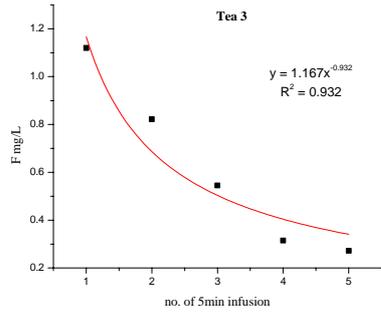
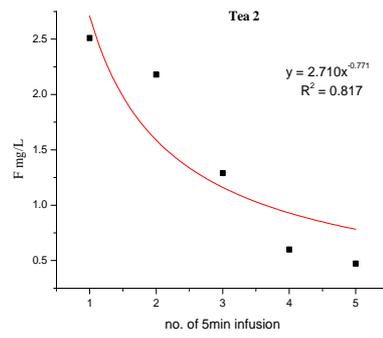
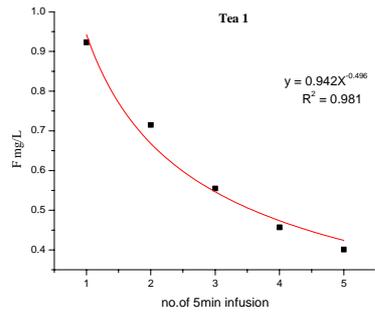
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(5 30 60 120 360)

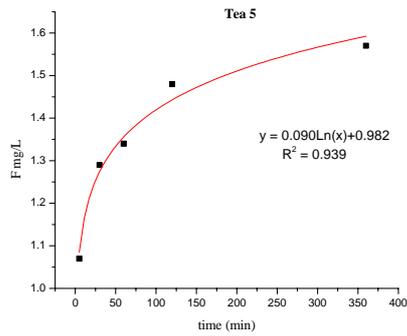
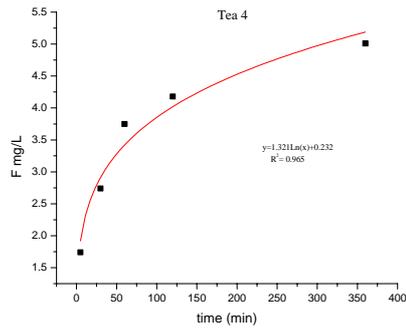
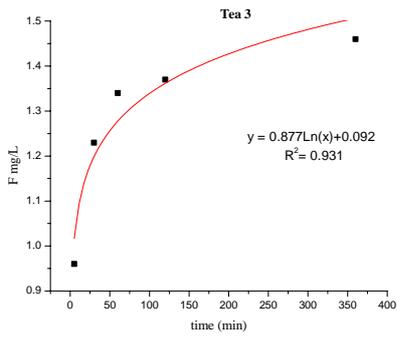
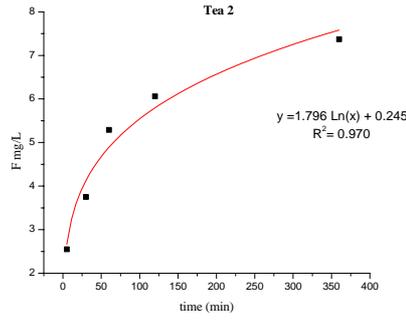
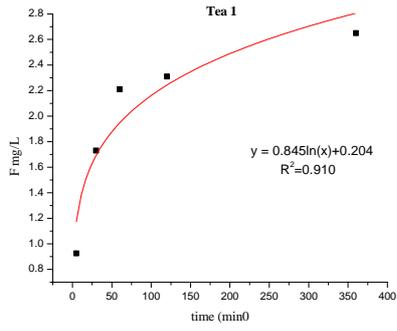
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( / ) (6)  
( )

|       |       | 360  | 120  | 60   | 30   | 5     | ( ) _____ |
|-------|-------|------|------|------|------|-------|-----------|
| 1.960 | 0.606 | 2.65 | 2.31 | 2.21 | 1.73 | 0.925 | 1         |
| 5.004 | 1.696 | 7.37 | 6.06 | 5.29 | 3.75 | 2.55  | 2         |
| 1.272 | 0.172 | 1.46 | 1.37 | 1.34 | 1.23 | 0.96  | 3         |
| 3.484 | 1.138 | 5.01 | 4.18 | 3.75 | 2.74 | 1.74  | 4         |
| 1.35  | 0.172 | 1.57 | 1.48 | 1.34 | 1.29 | 1.07  | 5         |



( 5 / )



( / ) (6)  
 .( )

(1 1 )

(2 )

(5 ) / 2.773

(3 ) / 0.85

(5 ) 0.927

(Fung et al,1999)

/ 1.60 / 1.89

(2 2 )

14.825 (2 )

/ 5.937 (3 ) /

/ 4.642 (5 )

(3 3 ) :

0.1 0.01

/ 20 (2 )

/ 5 (5 )

(3 ) (1 )

(5 1)

(5) :

/ 7.05 (2 )

/ 1.67 (5 )

(Fung et al,1999)

$$4 \quad / \quad 4.24 - 7.05 \quad . \quad 5 -$$

$$/ \quad 2.5 \quad 0.3$$

$$. \quad / \quad 1.3 \quad 0.1$$

$$.5 \quad 2$$

$$X \quad y=a.X^{-b} : \quad (5 \quad )$$

$$100 \quad 1$$

$$y \quad 100$$

(Sha and Zheng,1993b,Fung et al;1999)

$$. y = 0.7937 X^{-1.22}$$

$$y = 0.971 X^{-1.643} \quad (5)$$

(6) :

$$2.65 - 0.925 \quad / \quad 7.37 \quad 2.55 \quad 2$$

$$1 \quad / \quad 5.01 \quad 1.74 \quad 4$$

$$. \quad /$$

$$5 \quad 3$$

$$( Fung et al,1999 ) \quad (Sha and Zheng,1993 )$$

$$1.44 \quad 1.37 \quad 360$$

$$3 \quad /$$

$$. \quad / \quad 1.46 \quad ( \quad )$$

(6 )

$$y = aLn x + b$$

(Fung et al 1999)

$$y = 0.0949 \ln(x) + 1.0554 :$$

$$y = 0.09 \ln(x) + 0.982$$

1.57 / 1.67 (5 ) /  
 (Fung et al 1998) /  
 (She and Zheng,1993)

1.75 / 1.61 /

(WHO,1970;Levey,1994) .(WHO,1984)

$$/ 4 - 2$$

$$/ 13 - 14.48$$

: (Sha and Zheng,1993;Chao et al 1999)

(Editorial Community of Endemic Diseases and their Environments, People's Republic of china, 1989; Chao et al.,1995,1997 ).

(2) / 7.05

$$/ 4$$

$$/ 13$$

/ ( 0.6 - 1.2)

( 100/ 1 )

$$/ 5.04 - 5.01$$

$$/ 7.37 - 7.05$$

$$100/ 2 / 5.62 - 4.21$$

$$100/ 2 / 7.5 - 5.82$$

(Fung et al,1999) .( )  
 360 / 7.34 - 4.73 (Sha and Zheng,1993)

4 2

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(2002 ) / 0.3

-2

- - - - ) ( - - ) / 1.2

(2002

-3

- - - ) ( - ) / 0.6 4 2 (2002 ) /

.( 100 / 2 )

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1995 321-319 :

. 1999 66-60 /