

Studies Associated with Ascorbic Acid

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Investigations carried out in the Food Science Department in connection with ascorbic acid have followed two distinct and unrelated pathways:

1) The effect of 1 g daily doses of L-ascorbic acid in reducing the incidence of the common cold in a group of volunteers was compared with a control group receiving a placebo. The survey lasted 16 weeks during the winter months of 1971/1972. The results (1) showed that the 47 volunteers receiving L-ascorbic acid suffered a total of 44 colds, whereas the 43 people taking dummy pills had 80 colds. That is, 1 g L-ascorbic acid/day reduced the incidence of cold symptoms by 49%.

Pauling (2) has calculated an approximate

correlation between the dose level of L-ascorbic acid the reduction in the incidence of colds; for one gram per day he postulated a 45% reduction which is in agreement with our findings.

The results of the survey have been re-analyzed according to the sex of the volunteers and are summarized in the table,

Colds	L-ascorbic acid (47 persons)		Placebo (43 persons)	
	Males (24)	Females (23)	Males (3)	Females (13)
0	12	4	4	2
1	10	9	9	2
2	2	9	9	2
3	0	1	5	2
4	0	0	3	5
Cold/person	0.58	1.3	1.8	2.0

It is appreciated that the numbers are too small to make a definite claim, but there is an indication that adult males obtain more benefit than adult females in taking L-ascorbic acid to reduce the incidence of the common cold.

It is planned to repeat the investigation in Glasgow during the winter months of 1973/74 with a double-blind design and larger numbers in the groups. However, in carrying out this type of survey, weekly contact with a manageable number of volunteers is considered to yield more reliable results than larger groups with little, or no, supervision during the period of the survey.

2) L-ascorbic acid is used as an additive by the food industry to increase the nutritional value of a product and or for its antioxidant properties. However, it has established that in acidic conditions with free amino groups present, as occurs in citrus juices, L-ascorbic acid oxidizes to carbonyl compounds which subsequently polymerise and lead to non-enzymic browning (3). Claims have been made that the chemically synthesized isomer, D-isoascorbic acid (a permitted additive in some countries), oxidized preferentially and protects any L-ascorbic acid present (4).

Investigations with model systems at pH 4.0 have shown that the rate of breakdown of both isomers is similar when they occur in a mixture and that D-isoascorbic acid has no additional antioxidant properties for the protection of L-ascorbic acid (5). However, the breakdown products arising from the oxidation of L-ascorbic acid resulted in the development of more browning than with D-isoascorbic acid subjected to identical conditions.

Analysis of the carbonyls in the model

systems showed that L-ascorbic acid yielded a smaller number than D-isoascorbic acid during the early stages of incubation. This observation could be explained by the instant polymerisation of the 2,3-diketogulonic acid originating from L-ascorbic acid (6) yielding increased browning and fewer intermediate compounds, whereas the polymerisation of the 2,3-diketogulonic acid derived from D-isoascorbic acid was slower and further oxidation to smaller molecular carbonyls was able to take place.

Although L-ascorbic acid and D-isoascorbic acid exhibit some variance in their chemical properties, both isomers are affected by the presence of copper in a similar way resulting in accelerated breakdown and relatively increased browning (7).

RIASSUNTO

Studi sull'acido ascorbico.

In un gruppo di volontari sono stati studiati gli effetti della somministrazione di 1 grammo di acido ascorbico sul raffreddore comune. Si è constatato che l'incidenza del raffreddore è nettamente minore nei soggetti che ingerivano questa vitamina in confronto di quelli trattati con placebo.

La ricerca sarà ripetuta nell'inverno 1973-74 con un disegno sperimentale in doppio cieco e sopra un maggior numero di soggetti.

REFERENCES

- (1) CHARLESTON S.S. and CLEGG K.M. - *Lancet*, 1972, 1401. — (2) PAULING L. - « Vitamin C and the Common Cold », Bantam Books, U.S.A., 1971, p. 87. — (3) CLEGG K.M. - *J. Sci Food Agric.*, 1964, **15**, 878, — (4) ESSELEN W.B., POWERS J.J. and WOODWARD R. - *J. Ind. Eng. Chem.*, 1945, **37**, 295. — (5) BOULOS N.N. - M. Sc. Thesis, Food Science Department, University of Strathclyde, Glasgow, 1971. — (6) DULKIN S.I. and FRIEDEMANN T.E. - *Food Res.*, 1956, **21**, 519, — (7) FERGUSON S.M. - B. Sc. Thesis, Food Science Department, University of Strathclyde, Glasgow, 1973.

Clegg 1974

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Correction of published data

The number of placebo-males was not 3 but 30

The number of placebo-females who had 2 and 4 colds had been mixed

See comparison with the results published in Lancet 1972:

Published data in 1974				Same trial Published in 1972	
Colds	<u>L-ascorbic acid (47)</u>		Calculated Sum	<u>L-ascorbic acid (47)</u>	
	Males (24)	Females (23)		Both sexes (47)	
	0	12	4	16	16
	1	10	9	19	19
	2	2	9	11	11
	3	0	1	1	1
	4	0	0	0	0
Colds/person	0,58		1,3	0,94	
Colds	<u>Placebo (43)</u>		Calculated Sum	<u>Placebo (43)</u>	
	Males (3)	Females (13)		Both sexes (43)	
	0	4	2	6	6
	1	9	2	11	11
	2	9	2	11	14
	3	5	2	7	7
	4	3	5	8	5
Colds/person	1,8		2,0	1,86	

Calculated means:

L-ascorbic acid	0,58	1,30	0,94
Placebo	1,80	2,46	2,00

Differences in bold

Correction of the Cowan 1974 data
Corrections are in bold

Lancet June 24, p. 1401

Colds	<u>L-ascorbic acid (47)</u>		Calculated Sum	<u>L-ascorbic acid</u> <u>(47)</u>
	Males (24)	Females (23)		Both sexes (47)
	0	12	4	16
	1	10	9	19
	2	2	9	11
	3	0	1	1
	4	0	0	0
Colds/person	0,58	1,3		0,94
	<u>Placebo (43)</u>		Calculated Sum	<u>Placebo (43)</u>
	Males (30)	Females (13)		Both sexes (43)
	0	4	2	6
	1	9	2	11
	2	9	5	14
	3	5	2	7
	4	3	2	5
Colds/person	1,8	2,0		1,86

Calculated means:

L-ascorbic acid	0,58	1,30	0,94
Placebo	1,80	2,00	1,86