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Vitamin C

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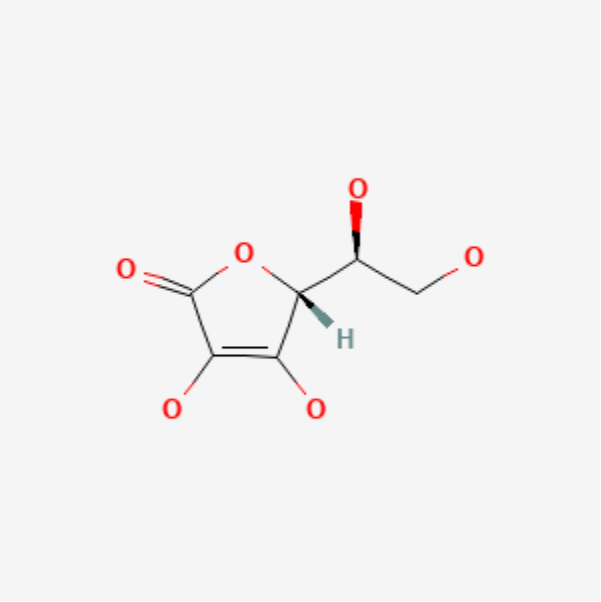

Drug Levels and Effects

Summary of Use during Lactation

Vitamin C is a normal component of human milk and is a key milk antioxidant. The recommended vitamin C intake in lactating women is 120 mg daily, and for infants aged 6 months or less is 40 mg daily.[1] High daily doses up to 1000 mg increase milk levels, but not enough to cause a health concern for the breastfed infant and is not a reason to discontinue breastfeeding. Nursing mothers may need to supplement their diet to achieve the recommended intake or to correct a known deficiency. Maternal doses of vitamin C in prenatal vitamins at or near the recommended intake do not alter milk levels.

Freezing (-20 degrees C) freshly expressed mature milk from hospitalized mothers of term and preterm infants does not change milk vitamin C levels for at least 3 months of freezer storage.[2] After 6 to 12 months of freezing

(-20 degrees C), vitamin C levels can decrease by 15 to 30%. Storage at -80 degrees C preserves vitamin C levels for up to 8 months, with 15% loss by 12 months.[3]

Drug Levels

Maternal Levels Average mature milk vitamin C concentrations are 50 to 90 mg/L in mothers consuming adequate vitamin C in their diet.[4-8] Milk concentrations are not markedly increased with routine daily multivitamin supplementation.[6,8-10] Vitamin C levels are higher in colostrum by 10 to 20 mg/L compared with mature milk.[11,12] Levels are relatively stable until after 12 months postpartum when they begin to decrease slightly and reach 30% of previous levels by 18 to 24 months postpartum.[4]

Milk levels correlate with blood levels, and both are influenced by maternal diet, particularly in poorly nourished mothers whose milk levels respond more robustly to increases in dietary vitamin C intake.[13,14] Mothers who smoke have lower milk vitamin C levels than those who do not, which is consistent with the known negative effect of smoking on human blood vitamin C levels.[15,16]

Milk from poorly nourished mothers with inadequate vitamin C intake has vitamin C levels of 30 to 50 mg/L during the first postpartum week, and 20 to 30 mg/L in mature milk.[15-17] Supplementation of deficient mothers with doses of 100 to 200 mg daily increases the mature milk level slightly to 40 to 60 mg/L.[18,19]

Among mothers living in rural The Gambia, West Africa, blood and milk vitamin C levels increased during seasonal periods of increased dietary intake from vitamin C-rich fruit. Milk levels were 50 to 60 mg/L during April to June when mango availability and consumption was highest, and 40 to 50 mg/L during December to February when orange availability and consumption was highest. Milk levels were 20 to 30 mg/L at other times of the year when consumption of these fruits was lowest. Mothers were concurrently taking a dietary supplement providing 35 mg daily of vitamin C throughout the year.[13]

Pooled and pasteurized donor milk from milk banks in Ontario and British Colombia, Canada had average vitamin C levels of only 17.7 mg/L (range 1.9 to 43.2 mg/L) and 21.7 mg/L (range 0 to 68 mg/L), respectively.[17,20]

Fifteen well-nourished nursing mothers between 7 and 20 weeks postpartum were given 250, 500, or 1,000 mg vitamin C once daily for two days. Average milk levels were between 100 and 120 mg/L and did not significantly differ between the groups. The maximum level reported was 158 mg/L.[11] Using this maximum level, an exclusively breastfeeding infant would be expected to consume about 25 mg/kg daily, which is similar to the treatment dose for infants with scurvy, and well below infant exposures known to cause harm.[21]

A case report from the U.S. of a well-nourished mother taking vitamin C 4,000 mg per day throughout pregnancy and lactation had a milk level of 105 mg/L on day 38 postpartum.[22]

Fifteen mothers who delivered preterm infants between 27 and 35 weeks gestation had average mature milk vitamin C levels of 120 to 130 mg/L compared to 95 to 120 mg/L in 12 term mothers. Both the term and preterm mothers had adequate dietary vitamin C intake plus were taking dietary supplements containing 60 to 270 mg daily of vitamin C. This study suggests that preterm infants fed their mother's milk are not at greater risk of vitamin C deficiency than term infants.[23] These investigators measured both ascorbic acid and dehydroascorbic acid in milk samples which may have accounted for their higher reported levels compared to other studies.

Maternal administration of a 500 mg vitamin C plus 100 IU of vitamin E daily for 30 days increased biochemical markers of milk antioxidant activity in healthy lactating women between 1 and 6 months postpartum compared to no supplementation.[24]

Infant Levels. Relevant published information was not found as of the revision date.

Effects in Breastfed Infants

Sixty healthy lactating women between 1 and 6 months postpartum exclusively breastfeeding their infants were given vitamin C 500 mg plus vitamin E 100 IU once daily for 30 days, or no supplementation. Infants of supplemented mothers had increased biochemical markers of antioxidant activity in their urine. Clinical outcomes were not reported.[24]

Eighteen preterm infants, seven of whom were less than 32 weeks gestational age, who were fed pooled, Holder-pasteurized donor milk beginning during the first three days of life had their average blood plasma ascorbic acid concentrations decrease from 15.5 mg/L at birth to 5.4 mg/L by 1 week of age, and to 4.1 mg/L by 3 weeks of age. The authors described the 1- and 3-week levels as subtherapeutic (<6 mg/L) and indicative of inadequate intake, potentially jeopardizing postnatal growth potential.[25] Although this study was conducted before advances in the provision of parenteral nutrition and enteral milk fortification for preterm infants, contemporary studies suggest that inadequate vitamin C intake from pooled, pasteurized donor milk may be a potential health problem for preterm infants receiving donor milk.[17]

Effects on Lactation and Breastmilk

Relevant published information was not found as of the revision date.

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Substance Identification

Substance Name

Vitamin C

CAS Registry Number

50-81-7

Drug Class

Breast Feeding

Lactation

Milk, Human

Vitamins