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# Human placenta processed for encapsulation contains modest concentrations of 14 trace minerals and elements

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ABSTRACT

Maternal placentophagy has recently emerged as a rare but increasingly popular practice among women in industrialized countries who often ingest the placenta as a processed, encapsulated supplement, seeking its many purported postpartum health benefits. Little scientific research, however, has evaluated these claims, and concentrations of trace micronutrients/elements in encapsulated placenta have never been examined. Because the placenta retains beneficial micronutrients and potentially harmful toxic elements at parturition, we hypothesized that dehydrated placenta would contain detectable concentrations of these elements. To address this hypothesis, we analyzed 28 placenta samples processed for encapsulation to evaluate the concentration of 14 trace minerals/elements using inductively coupled plasma mass spectrometry. Analysis revealed detectable concentrations of arsenic, cadmium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, rubidium, selenium, strontium, uranium, and zinc. Based on one recommended daily intake of placenta capsules (3300 mg/d), a daily dose of placenta supplements contains approximately 0.018 ± 0.004 mg copper, 2.19 ± 0.533 mg iron, 0.005 ± 0.000 mg selenium, and 0.180 ± 0.018 mg zinc. Based on the recommended dietary allowance (RDA) for lactating women, the recommended daily intake of placenta capsules would provide, on average, 24% RDA for iron, 7.1% RDA for selenium, 1.5% RDA for zinc, and 1.4% RDA for copper. The mean concentrations of potentially harmful elements (arsenic, cadmium, lead, mercury, uranium) were well below established toxicity thresholds. These results indicate that the recommended daily intake of encapsulated placenta may provide only a modest source of some trace micronutrients and a minimal source of toxic elements.



*Abbreviations:* AI, adequate intake; As, arsenic; Cd, cadmium; Co, cobalt; Cu, copper; Fe, iron; Hg, mercury; ICP-MS, inductively coupled plasma mass spectrometry; Mn, manganese; Mo, molybdenum; Pb, lead; ppb, part per billion; ppm, part per million; Rb, rubidium; RDA, recommended dietary allowance; Se, selenium; Sr, strontium; U, uranium; Zn, zinc.

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## 1. Introduction

Maternal placentophagy, the postpartum ingestion of placental tissue and fluid by the mother, is a ubiquitous behavior among terrestrial mammalian species [1–3]. Humans represent a conspicuous exception to this rule, which is especially noteworthy given that the behavior is widespread among other primate species. Although written reference to medicinal placentophagy can be traced back nearly 5 centuries in Traditional Chinese Medicine [4], there is a distinct lack of evidence in the ethnographic literature to support claims that maternal placentophagy has been practiced by any human population as a longstanding or routine behavior [1,2]. Despite this lack of evidence to support a custom of maternal placentophagy in any culture, beginning in the late 1960s and early 1970s, recorded instances of human maternal placentophagy began to emerge in popular culture and in the scientific literature [5]. Placentophagy supporters rely on anecdotal evidence to illustrate the benefits of ingesting one's placenta postpartum and claim that it provides a host of benefits including improvements in postpartum mood, lactation, energy, and postpartum recovery, among other claims [6]. In 2013, Selander et al [7] reported the results of an Internet survey in which 189 women's experiences with postpartum placentophagy were investigated. The most frequently self-reported benefits of placentophagy were improved mood, increased energy, improved lactation, and decreased postpartum bleeding. Although 31% of the responses reported some adverse effects of placenta ingestion, these were minor and most frequently related to the unpleasant aftertaste or smell of the capsules (the form in which most women reported ingesting placenta). In addition, 98% of the women in this survey reported that they would engage in placentophagy again after the birth of another child. It is important to note that although this is the most comprehensive study to date of women's experiences with placentophagy, the responses were collected through convenience sampling limited to women with Internet access who chose to respond to the survey, and therefore, the results are not representative of the larger US or worldwide population of women who engage in the practice.

Despite claims that placentophagy provides benefits to the postpartum mother, little scientific research has investigated these anecdotal self-reports. Placentophagy advocates' claims include purported nutritional benefits [7,8], including a rich source of elemental micronutrients such as iron (Fe). To our knowledge, few studies have been conducted assessing the nutritional composition of human placenta. Snyder et al [9] determined the average percent of water, protein, fat, and ash content of human placenta. Other studies have assessed concentrations of micronutrients such as zinc (Zn) [10,11] Fe, copper (Cu), calcium [12], and selenium (Se) [13]. Phuapradit and colleagues [14] analyzed selected nutrients and hormones in heat-dried placentas from 30 Thai mothers. Hormone analysis included estradiol, progesterone, testosterone, and human growth hormone, whereas the nutrient analysis included percent macronutrients (protein and fat) and select micronutrients, including Fe, Zn, Cu, manganese (Mn), and magnesium.

Similarly, the potential health risks of human maternal placentophagy, including the content of potentially toxic elements in dehydrated and encapsulated human placenta, have been the subject of little to no scientific research. Previous studies that analyzed human placenta as a biomarker of toxic exposure are of relevance here, however. Beyond facilitating the exchange of gases and nutrients between the mother and fetus, the placenta also acts as a partial barrier to prevent some harmful substances from passing to the developing fetus [15]. Although some substances pass through this barrier with relative ease, the organ is known to accumulate other toxicants across pregnancy including some micronutrient and toxic elements. In 2001, Iyengar and Rapp [16] reviewed the published data regarding concentrations of trace toxic elements in human placenta to assess the organ's utility as a biomarker to identify toxic exposure. They found that although lead (Pb), mercury (Hg), and nickel seem to easily pass through the organ to the fetus, arsenic (As) is partially impeded and cadmium (Cd) is prevented from crossing the placental barrier to an even greater degree. Their findings for Pb, Hg, and Cd are similar to those of Schramel and colleagues [17], indicating that of these toxic elements, Cd would present the highest risk for placental accumulation. More recently, Sakamoto et al [11] investigated concentrations of Hg (both methylmercury and inorganic Hg), Pb, Cd, Se, Zn, and Cu in freeze-dried chorionic tissue from the placenta and umbilical cord from 48 Japanese mother-child pairs at birth. Their findings revealed significantly higher concentrations of all elements except for methylmercury in placental vs cord tissue. Of all of the elements examined in the study, however, the placenta provided the strongest barrier to Cd, which suggests that placental tissue can provide a good indication of maternal exposure to this toxic element during pregnancy. In addition, analysis of toxic elements in maternal and fetal cord blood is frequently used to assess exposure across pregnancy, and placental accumulation can be determined indirectly through these analyses [for examples, see 11,18–20].

The accumulation of toxic elements in the placenta is of concern considering the increasing popularity of placentophagy which is touted by proponents as a natural and beneficial postpartum practice [6]. If the placenta does in fact retain some harmful elements in sufficiently high concentrations that persist throughout the processing and encapsulation process, these elements would then be ingested by the mother and could potentially adversely impact her health or the health of her newborn through exposure to contaminated breast milk. Research suggests that some toxic elements that may be retained by the placenta can not only elicit harmful effects such as nausea and vomiting in sufficiently high, acute doses but also function as endocrine disruptors [21,22]. For example, Piasek et al [23] investigated the effects of smoking on placental metal concentrations by evaluating the placentas of 56 women for concentrations of Pb, Fe, Zn, and Cu and assessed progesterone levels as well. They found that among mothers who self-identified as smokers, not only were Cd levels elevated but Fe and progesterone levels were depressed, suggesting a relationship between increased Cd exposure and decreased Fe availability and progesterone production. If exposure to toxic elements does have the ability to