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Shedding lights on the diversity and nutritional benefits of small dried fishes in Madagascar

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Madagascar is renowned for its wide range of aquatic organisms, particularly crabs, octopus and fish. The latter are particularly abundant and are sold in a variety of forms (fresh, salted, smoked or dried) and sizes, ranging from large to small individuals. Small dried fish (SDF) are abundant and omnipresent across Malagasy markets. However, they remain poorly understood in terms of their cultural and taxonomic diversity, as well as their nutritional benefits. As an accessible and affordable food source, SDF could help alleviate micronutrient deficiencies, a major issue in Madagascar. In this study, we explored the diversity and nutritional importance of SDF sampled at 16 markets and 12 towns along the National Road 7, which connects Toliara (coast) to Antananarivo (inland). For that purpose, we combined: (i) a socio-economic survey of 112 vendors, (ii) taxonomic (traditional and molecular) analyses to identify the diversity of fish species sold across 131 batches of SDF, and (iii) nutritional and heavy metal analyses of the 10 most popular batches. We assessed their the potential intake of key nutrients and heavy metals from SDF and contribution to Recommended Dietary Allowance (RDA) and maximum Tolerable Weekly Intake (TWI), respectively, considering daily? portions of 10 g for infants (7-11 months) and 20 g for both children (1-3 years) and women of childbearing age (15-50 years). We identified 43,819 individual fish specimens corresponding to 8.1 kg across the 131 batches sampled. These specimens were classified into 233 morpho-species belonging to 110 genera and 61 families, with the Clupeidae, Engraulidae and Poeciliidae families being the most represented in terms of both biomass and abundance. Thirty distinct types of SDF were characterized, of which 19 are commonly consumed by humans, such as the freshwater fish varieties Pirina and Varilava, with appreciation rates of 89% and 83% respectively. SDF are mainly consumed with rice, cassava or maize, and are generally prepared in sauces, fried or mixed with leafy vegetables. Consumption of SDF provides essential

nutrients for humans. Across the three population groups, SDF contribute at least 30% of the RDA for selenium, calcium, phosphorus, magnesium and iron. For infants, a 10g portion could meet more than 81% of daily calcium and selenium RDA. Most SDF also provide more than 42% of the RDA for iron and 29% for manganese. For children 1-3 and women of childbearing age, a 20 g portion covers more than 100% of the RDA for calcium, selenium and iron, particularly for the Matsiroky, Kalatambo and Ambotsika types of SDF. In all groups, contributions to potassium, copper and zinc RDA were moderate. Vitamin A was not detected in the ten SDF lots, except for a small trace in Ambotsika. Some types of SDF (Matsiroky) exhibited by significant traces of arsenic, cadmium and lead, requiring moderate consumption. This study enhances our understanding of the potential role of SDF in health and nutritional security and identifies the types most likely to improve nutritional outcomes for the population.

Key words: Small dried fish, micronutrients, heavy metals, Recommended Dietary Allowance (RDA), food security, Madagascar