

In Natura Diet: Statistical Invariance Analysis and Synecoculture Experiment  
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## Biodiversity for food and nutrition

### Introduction & Objectives

When considering sustainable diet, small-scale, biodiversity-based ways of farming with potential introduction of underutilized edible species in our diet is important. Understanding statistical property of food composition in different species varieties and culture conditions is a fundamental basis to address possible adaptation of food production systems facing dynamic social and ecological changes. In this article, we propose an information theoretical framework on statistically invariant property of food composition distributions between different culture conditions, and perform extensive analysis with field experiment.

### Materials & Methods

We define the 2 ideal types of culture condition with ecological perspective, namely in natura and in cultura, that can evaluate any form of food production systems from wild, natural to artificially controlled state.

We analyzed FAO/INFOODS Food Composition Database for Biodiversity Version 2.1 (BioFoodComp2.1) by separating the products into two categories: in natura for wild species and in cultura for non-wild species. Statistical invariance is analyzed with the use of information geometry on the basis of general nutrition intake distribution derived from the diversity limit of food system.

Besides, we established an experimental plot with a novel method based on the production with ecological optima, namely Synecoculture, for a constitutive experiment of in natura diet with cultivars. 4 minerals (Na, K, Mg, Ca) was analyzed from 140 samples between Synecoculture products and conventional food composition table to test the statistical invariance features between in natura and in cultura diet.

### Main Findings

In natura and in cultura diet of Infoods database showed statistical asymmetry in cross-referential information discrepancy as well as its mean and variance components correlation.. This tendency was also confirmed between Synecoculture products and corresponding conventional food composition table.

### Conclusion & Recommendations

The results suggest that the compositional difference between in natura/cultura diet depends rather on ecological condition than genotypic modification. This implies that the development of in cultura diet associated with agriculture development may have brought irreversible impact on human metabolism where variance components showed significant difference than mean components. In designing the

biodiversity-based agriculture and sustainable diet, the relation between in natura/cultura diet and health benefit/risk should be investigated with higher-order statistics where culture conditions affect statistically invariant properties of nutrition intake.

key words: food composition diversity, statistical invariance analysis, culture condition