Monitoring Individual Food Intake of Socially Housed Non-Human Primates

Data Source: Yerkes National Primate Research Center, Emory University

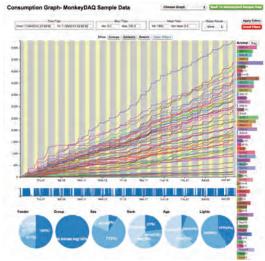### Food Intake

Figure 1: Cumulative intake of all rhesus monkeys from 11/01/13 until 11/30/13.
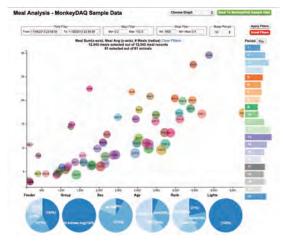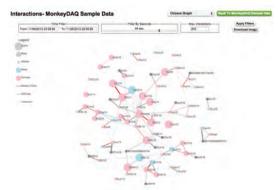
Meal Analysis

Figure 2: Figures 2 Cumulative meal sum (x-axis), average meal size (y-axis), meal number (radius) for 1 month.

Feeding Interactions

Figures 3: Feeding Interactions are calculated and displayed based upon the temporal association of feeding events relative to other animals in the colony. Social ranks were determined and assigned to animals through observation by Yerkes Research Center scientists. Mapping of feeding interactions shows strong correlation of family relationships. The tool is useful to identify animals' feeding relationships in the context of social rank as well as animals that are isolated eaters.

BioDAQ® NHP

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Food intake behavior of socially housed NHPs

BioDAQ NHP is a commercially available instrument that measures and records feeding bouts of socially housed, RFID implanted, non-human primates. Each BioDAQ NHP feeding station has a multiple kg capacity food hopper equipped with a dispensing system that meters food pellet(s) onto a weighing platform.

Once dispensed, the food pellets are weighed and a gate is opened allowing access to the pellets by NHPs. The food is accessed via a tube fitted with an RFID microchip reader which identifies animals via unique microchips implanted in the wrists of each animal. NHPs reach through the tube to remove the weighed food pellets. The identity of the animal is acquired and associated with the date, time, and the amount of food removed. After the food is removed, the gate closes and the process repeats.

Food Restriction

The weighing, RFID reading, and gating features allow individual, ad libitum food intake recording, or food restriction of individual animals by time, amount, and type of food. Multiple diets can be provided to a group of NHPs, with access to specific diets allowed on an individual basis. In addition, animals can be calorically restricted on an individual basis.

Data Collection

The system runs in a Power over Ethernet configuration with a single network cable per feeding station. Intake data are stored and managed on a local or remote server or both simultaneously. The BioDAQ Online DataViewer provides a flexible analysis and graphics tool to study NHPs food intake parameters. Optional Video cameras record motion detected feeding events.

The BioDAQ NHP is available for multiple NHP species, including rhesus macaques, baboons, African greens monkeys and cynomolgus macaques.

Rhesus monkeys feeding at BIODAQ NHP Feeding Station, Yerkes National Primate Research Center, Emory University

Researcher view: Feeding station local controller allows local field system monitoring, calibration, and validation.

NHP access perspective. NHPs reach through the RFID reader tube to access metered food, or present RFID chips to access individually restricted diets.

BioDAQ NHP Feeding Station Opened/Service View: Retractable assembly allows food hopper refill, cleaning, maintenance, and calibration out of reach of the NHPs. Each feeding station is a semi-autonomous unit. Multiple units can be installed on large pens or cages, indoor or outdoor with optional awning.

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RESOURCE CENTER

Contact our Resource Center for valuable insight from more than 30 years of product experience in formulating purified OpenSource primate diets. Let us formulate the diets to meet your specific study needs.

Custom OpenSource Diets
Our scientists specialize in providing custom purified OpenSource diets. By carefully designing the diet formula to fit your protocol, you have complete control over small or large changes in diet composition. Plus you are able to report what your animals were fed, repeat the formula and revise diet composition as necessary.

Incorporate Test Compounds
Research Diets, Inc. will incorporate your test compound into pelleted diets for simple, safe dosing. Feeding test compounds eliminates dosing related stress to the animal, eliminates vehicle effects, and saves time and labor. Consult with one of our scientists on the formula, determine the dosage required and the diet will be produced and shipped in 5 to 7 business days.

Value Added Resource
The value of our products is in the scientific support we provide. Our Resource Center is staffed with Masters and Ph.D. level scientists with access to over 25,000 original formulas and a database of about 10,000 journal articles. We welcome the opportunity to talk science with researchers throughout the world as we maintain our leadership role as the knowledge base for OpenSource Diet formulation.

BioDAQ Episodic Intake Monitor
BioDAQ E2 Episodic monitoring system measures the ad libitum food and water intake behavior of singly housed lab rats and mice at very high resolution in their home cage. Computer controlled electronics record food and water intake episodically by measuring the moment-to-moment, undisturbed intake behavior of the animals being studied. BioDAQ E3 features a programmable automated gate to restrict access to food or liquid by time or amount consumed.

Choose the diet wisely for your work with Non-Human Primates

OpenSource Diets

Purified OpenSource diets allow you to have much more control of what you're feeding your animals relative to conventional grain-based chows or 'chows' for short. This is mainly due to the use of refined ingredients in OpenSource diets. Our formulas are completely 'open' to you, the researcher, allowing you to accurately report the diet composition. Furthermore, the use of refined ingredients allows for better control of the nutrient composition because each ingredient contains one main nutrient, allowing us to repeat the nutrient content again and again with minimal variation. Finally, the fact that we use refined ingredients allows you to revise the nutrient contents of the formula with ease. This is in contrast to chows, which contain ingredients that each provides multiple nutrients and non-nutrients. One common ingredient in many chows is soybean meal, which provides protein and other nutrients (i.e. fat, fiber, carbohydrate, vitamins and minerals) as well as non-nutrients such as phytoestrogens.

Soy Isoflavones from chows can affect the metabolic phenotype of Non-Human Primates (NHPs)

Isoflavones are a class of phytoestrogens that undergo digestion and metabolic transformation by gut bacteria to form several metabolites including genistein, daidzein, and equol, leading to elevated levels of these metabolites in the blood. NHPs fed chows containing soy isoflavones can cause serum isoflavone levels to be quite high (over 1,000 ng / ml) [1,2]. As you may expect, dietary soy isoflavones can dose-dependently influence serum isoflavone levels [3], but other factors including diet composition, age and gender are influential [1,2]. For example, 2 year old male and female NHPs fed the same level of soy as their 7 year old mothers had approximately 3-fold higher concentrations of serum isoflavones compared to their mothers [2].

Isoflavones have similar chemical features to the natural hormone estrogen, and therefore can have estrogenic or anti-estrogenic activity. Because they target estrogen receptors as well as non-estrogenic targets, the presence of isoflavones in the blood is capable of affecting the development of many disease phenotypes including carcinogenesis, adipogenesis, glucose regulation, inflammation, lipid metabolism, and atherosclerosis [4]. The potential effects of isoflavones on the phenotype can be influenced by various factors. For example, age can affect how isoflavones influence the phenotype as younger NHPs fed a chow with soy had improved glucose tolerance relative to a casein-based chow, but soy was not protective for their mothers [2].

The authors hypothesized that the effect of isoflavones on glucose tolerance in younger NHPs was due to their elevated isoflavone levels compared to their mothers [2]. In addition, the dose of isoflavones can have variable effects on a given phenotype. Isoflavones are likely key to soy's anti-atherogenic effect in NHPs [5], but the concentration of isoflavones in the diet can have a differential influence on plaque regression, depending on the arteries being studied [3, 6].

Given the potential variability of phytoestrogen levels in different batches of chows, and the variable influence of soy isoflavones on various metabolic phenotypes in NHPs, the use of phytoestrogen-free OpenSource diets is ideal for researchers using this model for metabolic disease research. As pointed out by Stroud et al. [1], "…given the pleiotropic effects of estrogen, studies should use soy-free diets for animals so as not to confound or mask results."

References

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