Optional Science Paper: Topic Food vs. Fuel

Every 5 years, the United States Department of Agriculture (USDA) and Department of Health and Human Services (HHS) establishes dietary guidelines for Americans which reflect current health and nutrition science and are used in establishing a “science-based foundation” for nutrition policies and programs across the United States. (ODPHP, 2019) The once popular Food Pyramid developed in 1992 which provided a visual representation of the food groups and focused on the concepts of variety, moderation and proportion, gave way to the My Pyramid Food Guidance System in 2005 which banned oils and incorporated the concept of physical activity. Presently, MyPlate visually represents the proportions required for healthy eating, incorporates interactive online tools with customized guidance and stresses the nutritional message - everything you eat matters, make healthy choices and maintain a heathy diet over your entire lifetime. (USDA, 2018)

Eating healthy helps prevent chronic diseases like obesity, heart disease, high blood pressure, and Type 2 diabetes. (ODPHP, 2016) A healthy diet requires getting the right mix of nutrients (FDA, 2018) such as, total fat, saturated fat, trans fat, cholesterol, sodium, total carbohydrates, sugars, fiber, vitamins, protein (NASA, 2003-2004) and calories. (USDA, 2018) Calories and nutrients provide fuel to the body and help maintain energy levels. While the daily recommended caloric intake for an average person is 2000 calories/day, it ranges from 3000-4600 for a male soldier – an astronaut requires 3500 calories /day. (NASA, 2005-2006)

All food issued to soldiers, must meet nutritional standards, both military dietary reference intakes (MDRIs) and nutritional standards for operational rations (NSORs) established by The Office of the Surgeon General (TOSG). The NSORs, are based on the dietary guidelines established by the USDA and HHS for civilians, and modified based on scientific findings to provide the nutrients, vitamins, and minerals to optimize the human performance of a soldier. These standards are reviewed every 5 years or revised sooner if new scientific information on nutritional needs become available, or new nutritional policies are adopted. (AR-40, 2017)

As indicated, soldiers have very different nutritional and caloric needs than the average person. These nutritional needs may vary depending on the soldier’s mission. Factors such as the weight of clothing and equipment being carried or worn, and the operational environment (high altitude, sea level, extreme hot or cold) will affect nutritional and caloric needs.

The first rations issued to soldiers during the Revolutionary and Civil Wars, have greatly improved as advances in food technology and food processing have been adapted and incorporated into rations alongside state-of-the-art guidance on nutrition, caloric intake, health and exercise. Cans used in 1950 era rations to protect food from gas, spoilage and dampness have evolved over the years into today’s operational rations, which incorporate foods which are shelf stable, freeze dried and dehydrated, and include oxygen scavengers or humectants in flexible packaging designed to limit light, oxygen and moisture from effecting the nutritional value and safety of the food packaged inside. Advanced processing methods allow fresher tasting food with higher nutritional values and extended shelf-lives. Menu choices, developed with soldier sensory input (if soldiers do not like it, they will not eat it), are designed to maintain and enhance operational performance and boost morale. (CFD, 2015)

The 1980's marked a period of transformation in combat feeding when Meal Ready to Eat (MRE) individual meals were issued to soldiers. MREs continue to be the primary food source for troops in battlefield scenarios. Each MRE provides approximately 1300 calories (1/3 of daily requirement) composed of approximately 170 g of carbohydrates, 45 g of protein, and 50 g of fat for energy (fuel) (Kennedy & Scott, 2015) - high-fat, high-sodium nutrition suited for active combat duty (Dobson, 2014). While DOD develops MREs which meet the nutritional and caloric needs of soldiers, ultimately it is the soldier who decides what portions of the MRE they chose to eat or carry. Over the years, in addition to individual MREs other rations have been developed to meet specific mission/soldiers' needs such as: assault rations, (first strike rations or cold weather food packets), group rations, and special purpose rations such as tube foods (also used by astronauts), religious meals (Kosher), survival rations and ultra-high temperature milk**.** (CFD, 2015)

The 1990s marked a breakthrough in food preparation/service with the development of the Flameless Ration Heater (FRH) which provided soldiers in the field a way to heat MREs. The FRH heats an entrée to 1400F+ in 10 minutes using an exothermic/oxidation reduction reaction by exposing a magnesium-iron compound to water. (Oleksyk, Pickard, & Trottier, 1993) An improved air activated heater was developed in 2008 based on an exothermic oxidation reaction with Zinc (Zn). A major advantage of the air activated heater is the absence of hydrogen off-gassing (which raises some operational and transport safety concerns with the FRH.) (DellaRocca, Kainthla, Sesock, & Tinker, 2008) However, the air activated heater has not been fielded due to weight, bulk and heating performance.

The 21st century will be marked by the development of the most requested menu item by soldiers - pizza. One of the most challenging requirements of MREs is the need to be shelf stable for 3 years at 80 degrees Fahrenheit, and 6 months at 100 degrees Fahrenheit. (Kennedy & Scott, 2015) Developing bread items with a 3 year shelf life is particularly challenging due to moisture migration. "It took years to develop a spongy, stable bread with just the right amount of moisture, trapped with a blend of gums, oils, sugars and a touch of glycerol." (Philipps, 2018). The technical challenges with developing a MRE pizza were overcome by successfully maintaining the same level of moisture and ph in all the pizza ingredients – crust, sauce, cheese, pepperoni- to prevent the moisture of one from interacting with the other and causing spoilage. A sachet containing iron filings is placed inside the MRE to bind any free oxygen preventing oxidation and/or discoloration of the cheese. In addition, rosemary extract, was added in the manufacturing process to prevent oxidation or browning. (Woody, 2018)

DOD has undertaken many challenging food related problems over the years to provide soldiers with the best nutritional choices designed to maintain and enhance operational performance and boost morale. Many items designed for soldiers have been commercialized. Based on the difference in caloric requirements between soldiers and the average person, do you think this is contributing to obesity problems in the world today?

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