

Increasing Research into Use of Nanotechnology in Food Packaging: A Means to Reduce Food Insecurity Prevalence within the State of Florida

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Executive Summary. The purpose of this brief is to encourage the state of Florida to promote research into potential health risks associated with nanotechnology applications in packaging materials used for food products. Nanotechnology usage in food packaging shows great promise in reducing food insecurity throughout the state and thus improving the health and well-being of its citizens. However, there is a lack of knowledge on how nanoparticles produced from nanotechnology may affect the human body if absorbed. Therefore, it is recommended that Florida provide tax breaks and/or grants to companies and research institutions that seek to understand how the use of nanotechnology will affect food packaging.

Statement of the Problem. Food insecurity is serious health and economic problem for the state of Florida. Using nanotechnology in food packaging can reduce the incidence of food insecurity throughout the state by lowering the cost of foods, protecting their nutritional quality, and preserving them for longer periods of time. Unfortunately, significant knowledge gaps remain regarding the ways in which nanotechnology may affect public health when implemented in food packaging. This uncertainty stems from the extremely small size of nanoparticles. To adequately assess these potential consequences, more research must be funded. Florida should foster research that determines possible health risks associated with nanotechnology in food packaging.

Background. Approximately 17% of Florida's citizens are food insecure or about 3.1 million people.¹ More alarming still is that about 28% or 1.1 million of Florida's most vulnerable demographic, children, are affected by food insecurity.¹ The elderly are also at risk as a result of their reduced mobility, earning potential, and occasional tendency to not seek help when requiring assistance. This widespread nature of food insecurity is primarily a result of food costs, which are a consequence of

- lingering high unemployment levels, particularly in rural counties;
- increasing food prices in general; and
- the failure of food assistance programs (e.g. SNAP) to account for rising market costs of foods.²

These issues are compounded by a lack of food facilities (i.e. supermarkets, food pantries, etc.) in close proximity to some of the state's most impoverished residents, as reflected by the following:

- The formation of food deserts, or areas where people are unable to purchase or access affordable and nutritious foods
- The distances to places where nutritious foods can be acquired cannot be covered by foot or other non-motorized vehicle transport. This is exasperated in rural areas due to lack of public transit such as bus systems and larger distances between residences and businesses than in urban areas

- Increased shopping at local convenience stores within walking or bicycling distance. These stores typically carry less nutritious foods with higher fat and sugar contents due to lack of selection and capacity, and their products usually cost more than their supermarket counterparts
- Expiration of nutritious, fresh foods before the next trip to the supermarket resulting in reliance on processed foods high in unhealthy fats and sodium or even forgoing food altogether if access is not readily possible

For some suffering from food insecurity, the issue is not financial or geographic, but rather resulting from lack of proper storage, either at the producer or customer level. While this problem can be remediated with proper knowledge, advances provided by food packaging containing nanoparticles could allow food to increasingly withstand environmental factors such as heat, oxygen, or pathogen infiltration thus increasing its shelf life and healthfulness.³ Simultaneously, decreases in food costs could be achieved as less product would need to be disposed of due to expiration.³ A longer shelf life is especially advantageous for residents who live in rural or otherwise isolated areas where access to food services is minimal and requires them to stockpile between grocery store trips, particularly if they are reliant on others for getting to supermarkets. However, nanotechnology can have ramifications for human health as its effects within the body are less understood. Research has demonstrated the following:

- Certain nanoparticles can travel from packaging and into the food within contact such as nanosilver and nanocopper particles from polyethylene nanocomposites⁴
- The potential of nanoparticles to partition from packaging into stored food needs to be examined along with their effects within the human body once ingested⁵
- Many nanoparticles are smaller versions of their relatively large scale selves but have entirely different characteristics, especially emerging or increased toxicity⁵
- A nanoparticle may be safe for consumption based on its inherent chemical and physical properties but become toxic or carcinogenic under specific physical and chemical processes in the human body⁵
- Many processes of nutrient uptake and digestion within the human body are still not completely understood⁵
- Nanoparticles' small size allows them to move freely through the human body, particularly through cell walls causing cellular damages that may lead to diseases like cancer⁵

Diseases and Illnesses Resulting from Food Insecurity:

- Acute infections from common colds and influenza⁶
- Asthma⁶
- Developmental problems such as low birthweight⁷
- Diabetes⁶
- Heart disease⁶
- Hyperlipidemia⁶
- Hypertension⁶
- Iron-deficiency anemia^{6,7}
- Mental health problems such as depression and anxiety^{6,7}
- Obesity^{6,7}

Statement of the State's Interests. Food insecurity poses a significant threat to Florida's public health and economy. These two aspects are heavily intertwined, and Florida's reputation with respect to the United States and the rest of the world is heavily reliant on them. Habitual food insecurity leads to poor physical and mental health,

resulting in chronic illness in adults and especially children. These health problems extend from those who are experiencing them to their loved ones and to the public as well. As one example, children suffering from chronic illnesses are more likely to be admitted to a hospital at an average cost of \$12,000; this cost is then passed on to businesses as insurance and tax burdens.⁷

Furthermore, links have been found from children experiencing chronic food insecurity to developmental impairments that limit physical, intellectual, and emotional development. From birth until about age three, a child's cognitive development is in its most crucial period. If children experience food insecurity during this time, they cannot learn as much, as fast, or as well due to undernutrition.⁷ As a result, many of these children are being placed in special education programs, requiring more money to be allocated to their education. Many of these children, it is believed, would be perfectly able to excel in the standard education curriculum if enough nutritious food was provided to them during pregnancy and their early childhood years.

Moreover, food insecure children are not as well prepared for school. These children typically show low performance in school due to lack of concentration, absenteeism, and feelings of stress and anxiety. Many of these children must seek mental health counseling for stress and anxiety along with the other feelings they have and their resulting actions. These children are also at a higher risk for a number of detrimental behaviors such as confrontational tendencies, theft, and not finishing high school.⁷

Young people who drop out of high school cannot attend many trade schools or colleges and find themselves ineligible for many jobs. With less high school graduates, there is less contribution to Florida's economy as those without high school diplomas typically make less than their counterparts who did complete high school. Further, many of those who did not complete high school are unable to fulfill and create many STEM related jobs. A lack of career opportunities may further increase activities of theft and other criminal actions in those already doing them or even encourage them in people without previous records of them.

Arguably, the most alarming observation is that many people who experienced food insecurity as children are physically, emotionally, and socially disadvantaged, which reduces their capability to support their economy and their communities as well as they otherwise would be expected.⁷ Allowing food insecurity to continue plaguing Florida's citizens threatens not just our state's high standard of living and quality of life but that of the entire United States of America. Food insecurity will create a workforce pool that is less competitive with lower levels of educational and technical skills and severely hampered human capital.⁷ Food insecurity further stunts economic productivity by

- increasing the quantity and frequency of employee sick days due to child illnesses that result from food insecurity;
- increasing job terminations resulting from excessive sick days being taken;⁷
- adults who do not eat enough nutritious or wholesome food tend to be less productive or consistently present to work as their well-fed coworkers;⁸ and
- higher health care costs that employers of food insecure individuals must meet.⁸

What's more, food insecurity is harmful to our state's social fabric. Food insecure individuals will often be less socially active due to their ailments or even out of embarrassment for their situation.⁸ Some are so ashamed of their situation that they cut others out of their lives.⁸ Food insecurity is damaging our social interactions, which are absolutely pivotal not just for our economy but also for our identity as a state. Without socialization, information distribution—the lifeline of our economy—diminishes. Meanwhile, food insecurity is also damaging family relationships, traditions, and cultures and thus threatens our state's diversity and heritage.⁸ A food insecure Florida is resulting in an unhappier Florida, which causes a less productive, less inviting society. If this problem continues to grow, those within our country and around the world will take notice and may choose to avoid the "Sunshine State" for business, leisure, and as a place to call home.

Pre-existing Policies and Regulations.

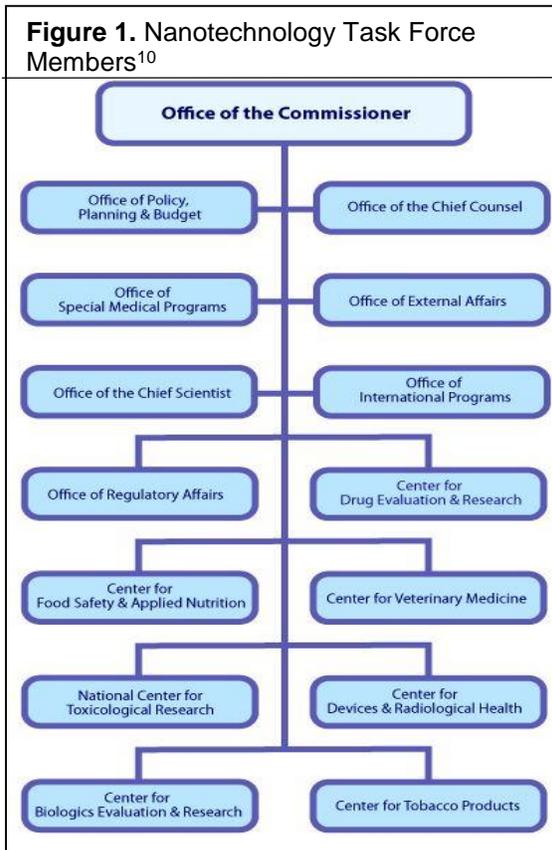
Below is a listing of current policies and regulations related to the use of nanotechnology in food packaging.

- **The FDA's Approach to Regulation of Nanotechnology Products⁹**

- Science based
- Focused on product
- Variations in legal standards for different products
- If premarket review authority *exists*, nanomaterials in new items are reviewed so more data on safety, effectiveness, and regulatory status can be given if needed
- If premarket review authority is *not required*, consultation is encouraged to lower potential for hazards to human or animal health and well-being
- Continuous monitoring after product is released to market
- Holds industry responsible for products meeting applicable legal and safety requirements while providing support to achieve those guidelines
- FDA and other administrations collaborate on regulatory policy issues

- **The FDA Nanotechnology Task Force¹⁰**

- Establishes regulations promoting ongoing development of innovative, safe, and effective products utilizing nanotechnology
- Finds and recommends ways to address information and policy gaps to determine potential health problems that may occur due to nanotechnology usage



- **Nanotechnology Regulatory Science Research Plan¹¹**

- Encourages proper and safe development of FDA-regulated products containing nanomaterials or that utilized nanotechnology during manufacturing
- Standardizes the instrumentation, methodology, and appropriate data to be used when aiding in regulatory decisions
- Provides scientific expertise for nanotechnology-related FDA-regulated products while cooperating with other US and global stakeholders

Figure 2. Nanotechnology Regulatory Science Research Plan Framework¹¹



Policy Options. Below is a list of policy options that are explored in this brief.

- **Option No. 1.** Establish state nanotechnology task force to work in conjunction with federal government to investigate and identify possible risks with nanotechnology infused food packaging.
- **Option No. 2.** Establish regulation that mandates industry to perform more research into nanotechnology use in consumer goods—notably food packaging.
- **Option No. 3.** Promote academic and industry research by offering tax breaks and/or grants for companies and academic institutions seeking to undertake research in nanotechnology usage in food packaging.

Advantages and Disadvantages of Policy Options. Below is a list of the advantages and disadvantages of each of the three policy options listed above.

- **Option No. 1 Advantage.** Establishes a task force that is dedicated to researching nanotechnology’s application to food packaging.
- **Option No. 1 Disadvantage.** The money to fund this initiative would be substantial and will need to come from an increase in taxes, an unpopular action, and/or from siphoning it from another program or programs.
- **Option No. 2 Advantage.** Forces industry to perform more research into nanotechnology’s effect on food packaging. Provides funding for nanotechnology and food packaging research at a reduced cost compared to Option No. 1 without accounting for the money and time involved in passing such legislation.
- **Option No. 2 Disadvantage.** Increased business regulations are often unpopular and may have the effect of pushing industries out of Florida, which would result in loss of state income from taxes along with possible extensive unemployment. Also, companies have an interest in promoting this technology, which may influence their research or leave the impression that it does.
- **Option No. 3 Advantage.** Money saved from tax breaks or gained from grants may spur further research into nanotechnology and food packaging.
- **Option No. 3 Disadvantage.** Institutions and companies may not use money saved from tax breaks to further research. Additionally, the tax breaks/grants

may increase taxes for the rest of taxpayers and/or reduce services and programs already funded through taxes.

Recommendation. Option No. 3 provides a better chance of achieving the aim of this policy proposal—increasing research into nanotechnology’s impact on food packaging to provide a more secure food base for the citizens of Florida. Option No. 1 would require substantial funding as professionals in industry and academia would need to be recruited and laboratory space and equipment would need to be supplied. Option No. 2 would require time and money to be spent in passing such regulation(s) and in the end may not succeed. However, if such regulation was passed many companies may leave Florida due to increasing costs for research and cause unemployment, to the detriment of our state. With Option No. 3, companies and universities with appropriate research facilities would be encouraged to carry out research in this subject to receive monetary support or tax reduction. This means the state does not need to set aside extra money for recruiting professionals or providing appropriate research facilities.

Annotated Endnotes. The following resources were used to support the statements made in this policy brief.

1. Feeding America. Facts About Hunger in Florida. (2012). Retrieved November 21, 2015, from <http://www.feedingamerica.org/hunger-in-america/news-and-updates/press-room/press-releases/facts-about-hunger-in-florida.html>

This webpage provides statistics on the prevalence of food insecurity within Florida and the overall United States along with information relating to SNAP. Most notably for the brief, this resource showed the extent of food insecurity in Florida by providing percentages and actual numbers of food insecure adults and children in the state.

2. Gregory, C., & Coleman-Jensen, A. (2013). Do High Food Prices Increase Food Insecurity in the United States? *Applied Economic Perspectives and Policy*, 00(00), 1-29. DOI:10.1093/aep/ppt024

This article determined that a positive, significant correlation exists between rising food prices and increases in prevalence of food insecure individuals. Individuals participating in SNAP were found to be at a much higher risk of suffering from food insecurity.

3. Ravichandran, R. (2010). Nanotechnology Applications in Food and Food Processing: Innovative Green Approaches, Opportunities and Uncertainties for Global Market. *International Journal of Green Nanotechnology: Physics and Chemistry*, 1(2), 72-96. DOI: 10.1080/19430871003684440

This article identifies and discusses some applications of nanotechnology in the food engineering field. In particular, the article mentions how nanotechnology can

be applied to food packaging and thus increase the healthfulness and stability of stored foods.

4. Cushen, M., Kerry, J., Morris, M., Cruz-Romero, M., & Cummins, E. (2014). Evaluation and Simulation of Silver and Copper Nanoparticle Migration from Polyethylene Nanocomposites to Food and an Associated Exposure Assessment. *Journal of Agricultural and Food Chemistry*, 62(6), 1403-1411. DOI:10.1021/jf404038y

This article investigates the use of nanosilver and nanocopper particles in food packaging. The results from this work show that these particles can travel from polyethylene food packaging to boneless chicken breasts in contact.

5. Buzea, C., Pacheco Blandino, I., & Robbie, K. (2007). Nanomaterials and nanoparticles: Sources and toxicity. *Biointerphases*, 2(4), MR17-MR172. DOI:10.1116/1.2815690

This work provides an overview of nanoparticle characteristics such as chemistry, size, and shape. The effects of these traits are applied to how they impact the human body.

6. Seligman, H., Laraia, B., & Kushel, M. (2010). Food Insecurity Is Associated with Chronic Disease among Low-Income NHANES Participants. *The Journal of Nutrition*, 140(2), 304-310. DOI:10.3945/jn.109.112573

This article discusses the association between chronic diseases and food insecurity for low-income NHANES participants. The work highlights ailments for adults and children.

7. Cook, J., & Jeng, K. (2009). Child Food Insecurity: The Economic Impact on our Nation. Retrieved November 21, 2015, from <https://www.nokidhungry.org/sites/default/files/child-economy-study.pdf>

This report examines the economic costs of children experiencing food insecurity. The focus is on the health care costs associated with illnesses and diseases due to food insecurity along with how this status affects children's future earning potential as adults.

8. Hamelin, A., Habicht, J., & Beaudry, M. (1999). Food Insecurity: Consequences for the Household and Broader Social Implications. *The Journal of Nutrition*, 129(2), 525S-528S. Retrieved November 21, 2015, from <http://jn.nutrition.org/content/129/2/525.long>

This article investigates the impact of food insecurity on families and other social groups. The work asserts that food insecurity is not just harmful for physical health but also for emotional health and is detrimental to the social fabric of many cultures.

9. U.S. Food and Drug Administration. FDA's Approach to Regulation of Nanotechnology Products. (2015). Retrieved November 21, 2015, from <http://www.fda.gov/ScienceResearch/SpecialTopics/Nanotechnology/ucm301114.htm>

This webpage outlines the FDA's regulatory approach towards the implementation of nanotechnology into consumer goods. This approach attempts to minimize risk and generate new knowledge while working with industry to meet these goals.

10. U.S. Food and Drug Administration. Nanotechnology Task Force. (2015). Retrieved November 21, 2015, from <http://www.fda.gov/ScienceResearch/SpecialTopics/Nanotechnology/ucm2006658.htm>

This webpage discusses the function and objectives of the FDA Nanotechnology Task Force. A graphic showing the membership of the Task Force is also provided.

11. U.S. Food and Drug Administration. 2013 Nanotechnology Regulatory Science Research Plan. (2014). Retrieved November 21, 2015, from <http://www.fda.gov/ScienceResearch/SpecialTopics/Nanotechnology/ucm273325.htm>

This webpage describes the FDA's research plan and goal relating to nanotechnology. A framework is also given along with an implementation plan and expected outcomes.