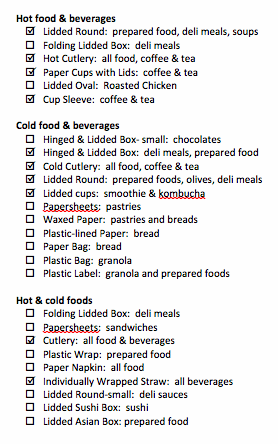
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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Report prepared for:  North Coast Cooperatives, Inc.  Arcata/Eureka, California  Food Packaging Analysis for Single-Use Co-op Products  Report prepared by  Zero Waste Humboldt P.O. Box 293, Arcata, CA 95518 839 Ninth Street, Suite C, Arcata, CA 95521 E-Mail: contact@zerowastehumboldt.org Web: www.zerowastehumboldt.org | |  | | --- | | Macintosh HD:Users:julie:Library:Application Support:SnapNDrag:screenshot_381.gif | |  | |  | | |
| |  |  |  | | --- | --- | --- | | August 14, 2015 | ZeroWaste | **Humboldt** | |

# Summary

Single-use packaging is widely used for the foods prepared and sold at the North Coast Co-op’s Delis and Prepared Foods departments. While the disposable cutlery, clamshells, bowls, and cups all provide convenient take-away food options and no dishwashing; they also fill trashcans, contribute to litter, deplete resources, and encourage a disposable lifestyle. The introduction of degradable, compostable, or other eco-friendly food packaging options, has created confusion as to whether these products are better for the environment than durable/reusable, recyclable, or compostable. Zero Waste Humboldt (ZWH) was contracted by the Co-op to evaluate disposable food packaging options for selected items. The food and beverage packaging was evaluated based upon Humboldt’s local recycling and composting market, environmental persistence, toxicity, and some sustainability factors. Eight single-use food service items commonly sold at the Co-op stores were evaluated from over 50 vendors and for 20 different material types. While some packaging materials may have more environmental benefits than others, there is only one good choice: reusable food and beverage containers.

 Figure . Check marked items were included in the evaluation

* Packaging that uses renewable resources, renewable energy, recycled or waste materials are preferable.
* The majority of food packaging consists of plastic or plastic lined products.
* There are no environmentally responsible single-use food packaging options.
* The only end of life option for most food packaging is the landfill.
* Any plastic, film, or coating (regardless if bio-based or petroleum-based) will contain leachable chemicals that may be harmful to consumer health.
* **Reusable food packaging is the only environmentally-sustainable choice**

The report aims to aid purchasers in asking the right questions or choosing the best packaging and to guide Co-op administrators to implement zero waste initiatives. Finally, this report concludes by summarizing various solutions available to the Co-op.

### **Single-Use Packaging Products**

ZWH inventoried food and beverage packaging used in the ~~deli and~~ prepared foods departments. With input from Co-op staff, a list of package types (Figure 1) was chosen for evaluation. Vendors that advertised environmental consciousness constituted the majority of the food packaging chosen for review.

Product performance (E.g., heat tolerance, leak proofing, etc.) was considered during the review. Out of the 143 package types reviewed, few were unstable at temperatures less than 185 °F. Additionally, most vendors offer free (or for a small fee) samples for testing the performance of their product. See Appendix 1 for a complete vendor and product list.

## Material Types and “Beginning of Life”

How an item was produced, what materials were used, and how much energy was expended are key factors. Traditional plastic production is highly energy intensive and uses fossil fuels. Unfortunately, most disposable food packaging is made from traditional plastic. Some environmental benefit may be gained if post-industrial or post-consumer waste can be used in the manufacture. NatureWorks, the largest manufacturer of bio-based plastic, reports that its manufacture uses 50% less non-renewable energy and emits 75% less greenhouse gases (1). Furthermore, bio-based plastics and other materials such as paper or wood, rely on renewable sources, which is preferable to fossil fuel. Bio-based, plant-based, and bio-plastic indicate that some or all of the product’s feedstock came from a renewable resource. Some products made from Bagasse (sugarcane), wheat straw, or forestry residue are reported to utilize waste material in order to extract cellulose; these manufacturers should be chosen over manufacturers that use virgin materials. Additional environmental benefits can be gained if the renewables are non-food and non-GMO crops. The overwhelming majority of bio-based plastics are made from GMO corn, which is a drawback. It remains important to keep in mind that products made from renewables may not be better for the environment when end of life options are weighed. The following tables include common material types of food service packaging.

|  |  |  |
| --- | --- | --- |
| Bio-based materials from renewable resources  Feed-stock Description Common Food Packaging Uses | | |
| Bagasse | Made from sugar cane or sorghum stalks (typically waste material) | Paper-like plates, clamshells, boxes, cups; may not require a liner to be water-resistant |
| Bamboo | Typically made from waste bamboo | Cutlery, plates, bowls |
| Bulrush | Cattails | Paper-like plates, clamshells, boxes |
| Cornstarch or plant starch | Soy, tapioca, or potato | Cutlery, is often blended with oil-based resins (traditional plastic) to increase the heat tolerance |
| Paper | Made from trees | Cups, sleeves, plates, boxes, typically lined with a plastic film for water resistance |
| PLA (polylactic acid) | Derived mainly from corn and through industrial processes results in a plastic product | Cups, clamshells, cutlery, boxes, straws, liners, etc. |
| Plant Fiber | Wheat straw, cattails, other cellulose-based plants, commonly from waste material | Paper-like plates, clamshells, boxes, likely requires a plastic liner for water-resistance |
| PET (#1) Polyethylene terephthalate | Can be made from corn but is typically derived from petroleum and is considered a traditional plastic | Bottles or cups |
| Wood | Birch, poplar, or aspen trees, common to use waste material | Cutlery |

Table

|  |  |  |
| --- | --- | --- |
| Petroleum-based materials from fossil fuels (traditional plastics)  Plastic RIC number Description Common Food Packaging Uses | | |
| PET (#1) | Polyethylene terephthalate | Beverage containers (cups, bottles), clamshells |
| PE (#2 or #4) | High or low density polyethylene | Liners for paper products, plastic wrap |
| PP (#5) | Polypropylene | Lids and caps, boxes, blended with plant starches for utensils and boxes |
| PS (#6) | Polystyrene | Clamshells, sushi containers, boxes, commonly used because it is a good vapor barrier |

Table . RIC = Resin identification code

## Toxicity of Food Packaging

Identifying if food packaging is toxic is a complicated task. For example, the research is focused by the type of concern: Is it the chemicals released during manufacture, everyday use, prolonged exposure, one-time use, or repeated use? Does the toxicity depend on whether or not the package gets hot or is microwaved? Is the concern for adult humans, infants, aquatic organisms, or wildlife? What is the toxic endpoint of concern: cancer, reproductive harm, irritation, allergic reactions, birth defects, sensitization, etc.? Depending on the questions asked, safety statements may change. For example, a food packaging material considered safe and nontoxic might be categorized as toxic if that same package was heated in a microwave releasing endocrine-active compounds. It is important to note that all food-packaging materials that come into contact with food must be FDA-approved (2).

That being said, many chemical additives are added to packaging in order to achieve the desired performance. Along with primary packaging material, the additives may leach into food and beverages. Chemical classes that have received recent attention include endocrine disruptors like phthalates or phenols (E.g., BPA or bisphenol A). Many other chemicals known to leach out of packaging have various other toxic endpoints at certain concentrations. All packaging material tested (E.g., plastics, paper, glass, aluminum, etc.), have been shown to leach chemicals into food and/or beverages (Table 3). Currently, there is debate about whether the concentrations of leached chemicals present harm to humans. In order to draw toxicity conclusions for this study, a review was conducted of many toxicity and leachate studies. Products were assessed according to their material type and the relative amount and strength of data to suggest that toxic chemicals leach from that material type (Table 3) (3)(4)(5)(6)(7)(8)(9). In general, it is best to avoid plastics since many chemicals are added and manufacturers are not required to disclose which chemicals are added.

|  |  |  |
| --- | --- | --- |
| Material Type | Toxicity Conclusion  by ZWH | References for leaching of chemicals and/or toxicity of leachates |
| Glass | **Not of concern** | Food Packaging Forum, Seltenrich, N. 2015 |
| PET #1 plastic | **Some concern** | Food Packaging Forum, Seltenrich, N. 2015, Yang, C. 2011, Bhunia, K. 2013, CalRecycles 2014 |
| PE #2 or 4 plastic | **Some concern** | Food Packaging Forum, Seltenrich, N. 2015, Yang, C. 2011, Bhunia, K. 2013, Lithner, D. 2012 |
| PP #5 plastic | **Some concern** | Food Packaging Forum, Seltenrich, N. 2015, Yang, C. 2011, Bhunia, K. 2013, Lithner, D. 2012, Simoneau, 2012 |
| PS #6 plastic | **Very concerning** | Food Packaging Forum, Seltenrich, N. 2015, Yang, C. 2011, Bhunia, K. 2013 |
| PLA #7\* plastic | **Some concern** | Seltenrich, N. 2015, Yang, C. 2011, CalRecycles 2014 |
| Paper | **Not of concern** | Food Packaging Forum, Seltenrich, N. 2015 |
| Silicone | **Some concern** | Food Packaging Forum, Seltenrich, N. 2015 |

Table . Toxicity summary from evaluation by Julie Layshock, PhD; \* #7 indicates any number of material types including PLA; not a complete listing of all references

## Recyclability of Food Packaging Material Types

End-of-Life, or what happens to the food packaging after it is used is an important consideration. Most end-use manufacturers that buy recyclable material as feedstock in their manufacturing processes, specify a small allowable percentage of contamination, or other materials mixed in. Therefore, in most circumstances, a package must be made of a single material type in order to be recycled. A paper coffee sleeve is typically recyclable because it is usually just paper. However, a paper coffee cup is not recyclable because of the plastic lining on the inside of the cup. This liner is required for the performance of the cup i.e., water and heat resistant. Similarly, a PE and PP blended clamshell would not be recyclable since the two types of plastics are mixed together. The most common bio-based plastic material, PLA, is not recyclable since there is no existing infrastructure to recycle post-consumer PLA. Although paper, glass, aluminum, and many traditional plastics (chasing arrows symbol with the resin code #1-7) can be recycled, (ie. used in the process of making new products) many are not.

Table 4 summarizes the latest recycling rates for the United States and California. Recycling rates are lowest for the plastics used in food packaging, such as the single-use packages in the Co-op’s Prepared Foods Section. Consumers have not established recycling habits for this packaging and the infrastructure to support recycling processing and manufacturing is not yet well-developed. This problem is compounded by the frequent, continual introduction of new forms of single-use “convenience packaging” into the marketplace.

|  |  |  |
| --- | --- | --- |
| Material Type | United  States | California |
| Aluminum | 55% | 96% |
| Glass | 34% | 76% |
| Plastic: | 9% | - |
| #1 PET | 31% | 70% |
| #2 HDPE | 28% | 70% |
| #3 PVC | 0% | 18% |
| #4 LDPE | 5% | 2% |
| #5 PP | 1% | 13% |
| #6 PS | 1% | 17% |
| #7 other | - | 4% |
| PLA | - | - |
| Other Compostable Plastic | - | - |
| Paper/paperboard | 63% | - |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Aluminum | Glass | Plastic | #1PET | #2HDPE | #3PVC | #4LDPE | #5PP | #6PS | #7other | Paper |
| U.S. | 55% | 34% | 9% | 31% | 28% | 0% | 5% | 1% | 1% |  | 63% |
| CA | 96% | 76% |  | 70% | 70% | 18% | 2% | 13% | 17% | 4% |  |

Table . United States data was calculated by the US EPA (10) as percentages of the amount recycled of the total generated material; California data was calculated by CalRecycles based on number of containers recycled and the number of containers sold.

## Mixed recycling collection or drop-off centers are convenient for most Humboldt County residents to deposit their discarded materials for recycling. However, the Humboldt Waste Management Authority’s current recycling processing contract requires that most of the County’s locally-collected mixed material is transported 145 miles to the Solid Waste of Willits materials recovery facility for sorting and processing. From there, the materials must be transported greater distances to domestic markets or to China. These long distances to the end-use markets for the materials make the economic benefits and often, the environmental benefits of recycling minimal for Humboldt County. A recycling infrastructure within our regional economy will improve this situation. At present, there are only two recycling manufacturers in Humboldt County that make new products with single-use food and beverage containers: Fire & Light purchases an ongoing supply of clear, crushed cullet from glass bottles from Humboldt Sanitation in McKinleyville. Their need for recycled glass is only a fraction of the total discarded glass bottles in Humboldt County. Their specifications are strict with no real allowable percentage of contamination because they make high value-added gift and tableware products. In Redway, J&T Molded Plastics Enterprises, Inc. manufactures “The Perfect Pot” growing pots for indoor growing and greenhouse gardening. They use 75% #2 HDPE mixed with a high flow polyethylene. The high flow polyethylene by itself is a very weak, nondurable plastic, but when #2 HDPE is added, it increases the durability. J&T had previously purchased the CRV plastic from Arcata Community Recycling Center. They have been selling their pots and other molded plastic products for 20 years. Because their molded products do not require the same aesthetic standards as Fire & Lights tableware, their specifications for percentage of contamination are not as strict, depending on the product made and its purpose.

## Currently, all other manufacturing enterprises that recycle single-use food and beverage containers are more than two hundred miles from the Co-op. This region needs more manufacturers that can integrate recycled feedstock into their production. Closing the recycling loop locally, helps to achieve the “highest and best use” of the materials.

## Because it has been easy for the West Coast to ship recyclable materials overseas, the infrastructure for preparing the materials to re-enter a manufacturing process is under-developed – especially for plastics. By comparison, the eastern half of the country has plastics recycling facilities (PRFs) that sort and process different plastic grades for manufacture into carpet, plastic and composite lumber, and a wide variety of products.

## Degradability and Compostability

Disposable food packaging labeled as degradable or compostable has created numerous issues including false advertising (green-washing), contamination of traditional recycling programs, and a mis-guided sense of doing the right thing. Many steps have recently been taken to ensure that product labels are not misleading (see the Federal Trade Commission’s Green Guide) and a few organizations now offer certifications that substantiate advertising claims.

* **Biodegradable Products Institute (BPI) -** Certifies that products meet the American Society for Testing and Materials (ASTM) composting and degradation standards: ASTM D6400 (covers plastic film and bags) or ASTM D6868 (plastic and paper packaging) (11). This is the most commonly encountered certification for food packaging.
* **Cedar Grove Composting (Seattle, WA) –** An industrial composting facility that test products labeled as compostable according to ASTM standards or BPI certified. Issues approved products a “brown-marked” certification(http://cedargrove.com/compostable/compostability-testing)
* **Green Seal**- Certifies that a product meets many criteria including but not limited to recycled content, bleaching, toxics, compostability, marketing, performance, volume-to-weight ratio. Very few food-packaging products have the Green Seal certification. 

Despite the various terms such as bio-based degradable, biodegradable, oxo-degradable, and compostable, “compostable” is the only useful term when considering end of life packaging options. Bio-based refers to the feedstock used to make the product, and the degradable terms mean that the product is capable of breaking into smaller pieces. The conditions and time scales are completely undefined for the “degradable” terms, rendering them meaningless. Compostable according to ASTM standards at least specifies a time frame and that the products needs to completely degrade. Compostable disposables are not a silver bullet and there are many concerns: 1) they are major contaminants to conventional recycling, 2) compostable packaging adds no value to the compost (completely degrades to carbon dioxide), 3) they require an industrial composting facility that may have different conditions than ASTM standards.

More importantly, the nearest industrial composting facility to the North Coast Co-op is Cold Creek Compost in Potter Valley, California, 165 miles away. **Cold Creek** **Compost does not accept any food packaging materials for composting.** This is important and it means that compostable packaging is going to the landfill in Humboldt County. End of life options for packaging reviewed in this study is summarized in Table 5.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| End of Life Options of Food Packaging by Material Type | | | | | |
| Material Type | **Packaging** | **Recycling** | **Backyard Compost** | **Industrial Compost** | **Most likely end-of-life scenario** |
| Bagasse, Plant Fiber, Bulrush, Bamboo, Wood | Plates, clamshells, boxes, cups, utensils | Not recyclable (no market exists) | May be composted in backyard if no plastic lining has been used | Not likely due to risk of contamination | Landfill or litter |
| Cornstarch or plant starch | Utensils | Not recyclable (blended materials) | Not Compostable | Not Compostable | Landfill or litter |
| Paper | Cups, plates | Not recyclable (plastic lining) | Not likely due to plastic lining | Not likely due to plastic lining | Landfill or litter |
| PLA and other compostable plastics | Cups, clamshells, boxes, utensils, straws, lids, etc. | Not recyclable (no market) | Not compostable | Usually compostable but this depends on manufacturer. Look for certifications. | Landfill or litter because no local industrial composter |
| PET (#1) | Cups, bottles, clamshells | Collected locally; great distance to markets | Not compostable | Not compostable | Landfill or litter |
| PE (#2 or #4) | Lining for paper products, plastic wrap | Difficult to separate and recycle | Not compostable | Not compostable | Landfill or litter |
| PP (#5) | Lids, caps, boxes | Difficult to sort and recycle | Not compostable | Not compostable | Landfill or litter |
| PS (#6) | Boxes, clamshells, sushi containers | Not recyclable | Not compostable | Not compostable | Landfill or litter |

Table

## Environmental Persistence

What happens to the disposable food-packaging materials when they end up in a landfill or as litter in the ocean or on land? Unfortunately, the time it takes for most manufactured single-use packaging to degrade is unknown because the materials are incredibility durable. Due to the relatively long persistence times, proper studies are impossible to conduct or measure for food packaging. A number of studies have shown that due to the leak and emission protections put in place in landfills, materials do not degrade at all. This means that landfills are preserving trash for decades, centuries, or possibly longer (The Garbage Project: http://www.mdpi.com/2071-1050/7/6/6994). If materials do degrade, methane (a possible greenhouse gas) is emitted.

As litter, paper-like food packaging such as bulrush or bagasse would be expected to degrade on timescales similar to paper, which is about 2-4 weeks on land (National Park Service) and 2-4 weeks in the ocean (12). If a plastic liner were used to coat the paper product, then the plastic would remain for an indefinite amount of time. Many claim plastics last forever on land or in the ocean. Compostable plastics left as litter are not expected to degrade because they were developed for conditions of a close-system, temperature-, moisture-, nutrient-, and microbial-controlled industrial environment. Because oceans are cold, salty, and likely lack microbes capable of degradation, compostable and/or bio-based plastics may behave similarly to traditional plastics- lasting a very long time if left as litter.

## Sustainability

Sustainability studies consider many variables in a multi-faceted cradle to grave analysis. A truly sustainable food packaging would have upfront environmental benefits (E.g., renewable feedstock), use renewable energy, limit water usage, avoid chlorine, lead and mercury, have reduced greenhouse gas and volatile emissions, be nontoxic, and have realistic end of life disposal and reuse options. No food packaging reviewed meets all of these criteria. Many food packages boast environmental friendly manufacturing (E.g., chlorine or lead free), or use renewable feed stocks, but almost all fall short on realistic disposal options. Currently, no product on the market offers a fully sustainable solution. The problem is that although some products may be recyclable or compostable, the infrastructure to collect, segregate, ship, and process the materials is not in place. Even if it was feasible to have a closed-loop cradle-to-cradle product, to constantly re-manufacture a product is not sustainable.

Some sustainability benefits for paper and paper-like products are that they can be manufactured using forestry or agricultural waste and they can be backyard composted if unlined with plastic. A Forest Stewardship Council (FSC) certification on paper products grown from trees reflects that the forest has been responsibly managed. Unbleached paper and chlorine-free manufacturing are other important criteria to look for when choosing a paper product. Renewables (E.g., sugarcane, corn, wheat straw) tend to have more energy-efficient manufacturing compared to the refining process required for fossil fuels.

Recycled content is another parameter that should be sought out when searching for sustainable packaging. A number of companies sell food-packaging items (cutlery, clamshells, cup sleeves, etc.) made from 20-100% post consumer waste. The Green Seal certification symbolizes that the product has been evaluated for a number of sustainable criteria. It should be noted that none of the 140+ products reviewed had the Green Seal certification. A durable reusable is truly the only sustainable food packaging option.

## Solutions and Reusables

Solutions involve transitioning from single-use food packaging and promoting reusable containers. A number of realistic reusable food and beverage containers were also reviewed as part of the analysis. Other solutions require commitment from Co-op administration.

What to look for:

* Reusable alternatives
* Highest post-consumer recycled content
* Feedstock from renewable resources
* Renewable energy for manufacturing
* Bio-based if plastics are chosen
* PET over all traditional plastics
* Unbleached, chlorine-free, liner-free paper products
* Products made from waste materials
* FSC-certified (for trees)
* Non-food and non-GMO feedstock
* Look for BPI certified compostable (if local composting becomes available)

* Focus on 1 of the 7 core principles: **Education, training, & Information**
* As an organization, the Co-op could raise awareness that anything single-use/disposable is a waste. Even if compostable packaging could be composted, energy was still required to make the product and upon composting, the resources are lost by conversion to carbon dioxide.
* The environmental enthusiasm of Co-op staff could be embraced and encouraged. Co-op staff members that ZWH interacted with were extremely devoted to reducing waste. An investment in staff training to promote bringing your own containers and to encourage customers to buy products with bottle or container deposits would be fitting.
* Co-op administration should embrace their role as local leaders and work with staff and local producers to develop three programs:

**Environmentally Preferred Purchasing Programs (EPP)**- develop or adopt an existing EPP to guide future purchasing. An EPP would define purchasing requirements like energy efficiency and recycled content. A Co-op packaging review board can help to avoid future wasteful problems and establish new zero waste standards. Patti Moore, a nationally-recognized plastics recycling expert, told us, “You have to ask, require, advocate for ***“Design for Recycling”*** of your vendors. If you don’t ask, you won’t get it.” There will always be new designs, new materials and new forms of packaging regularly brought to the marketplace. The Co-op can be prepared in advance with a process to vet these new packages.

**Extended Producer Responsibility Programs (EPR)**- the Co-op could work with local producers to minimize disposable packaging and encourage returnable containers and/or bulk containers for local products. The Co-op could also implement such a program for its Prepared Foods Department. EPR programs are heavily used in Europe and are becoming an attractive business proposition because the producer takes the responsibility, reducing recycling and disposal costs to stores, consumers, and taxpayers. Several business models already exist. A “take back the packaging” approach would be novel for food products in the US and presents an extremely exciting opportunity. Tetra Pak produces problematic, multi-material, difficult-to-recycle packaging. In response to criticism, they have created a model program for accepting their used packaging. A local program of this type could help achieve zero waste for the Co-op and the local supplier. Funding may be available through CalRecycles. ZWH has compiled a list of foundations and grantmaking agencies that support innovative waste reduction and consumer awareness programs

**Packaging Materials Reuse** - Determine if there are second uses for single-use food and beverage containers in businesses, agriculture, government operations, schools, etc. as containers for nonfoods, packaging, or other products. Determine the feasibility of sterilizing food and beverage containers so that they can be reused locally. Determine in discussions with Scrap Humboldt what their capacity is, and could become to be a regular drop-off warehouse for the Co-op’s single-use packaging, plastics, in particular.

The economic viability of a local bottle washing operation has long been discussed for Humboldt County’s growing number of food and beverage producers, especially local breweries. The economy of scale needed to make it work financially, has been difficult to achieve, and other factors in the sterilization of the glass bottles and jars for return to local producers are also complicated. Bottle washing is still an option worth pursuing.

* The North Coast Co-op Board can join other businesses and environmental groups to advocate for legislation in California and local government ordinances to:

(1)Ban or create disincentives for bringing wasteful, single-use, or difficult to recycle packaging (multi-material layers) into the County.

(2)Create incentives for eliminating single-use packaging, especially plastics; transition to refillable/reusable options.

(3)Provide incentives and support to local manufacturers to integrate single-use packaging and other discarded material as feedstock in their production processes to make new products. Economic development to improve the local recycling infrastructure.

(4)Join with other progressive grocery stores around the state to support legislation and educate shoppers about replacing single-use packaging systems with reusable/refillable packaging.

* Seek local solutions and forge new relationships for composting food waste and compostable food packaging. Until a local composting option is available, compostable food-packaging goes to the landfill.

# References:

1. NatureWorks. Eco-Profile for Ingeo [Internet]. Available from: http://www.natureworksllc.com/The-Ingeo-Journey/Eco-Profile-and-LCA/Eco-Profile

2. FDA. Packaging & Food Contact Substances (FCS) [Internet]. Available from: http://www.fda.gov/Food/IngredientsPackagingLabeling/PackagingFCS/ucm2006853.htm

3. Food Packaging Forum [Internet]. Available from: http://www.foodpackagingforum.org

4. Yang CZ, Yaniger SI, Jordan VC, Klein DJ, Bittner GD. Most plastic products release estrogenic chemicals: A potential health problem that can be solved. Environ Health Perspect. 2011;119(7):989–96.

5. Bhunia K, Sablani SS, Tang J, Rasco B. Migration of chemical compounds from packaging polymers during microwave, conventional heat treatment, and storage. Compr Rev Food Sci Food Saf. 2013;12(5):523–45.

6. Lithner D, Nordensvan I, Dave G. Comparative acute toxicity of leachates from plastic products made of polypropylene, polyethylene, PVC, acrylonitrile-butadiene-styrene, and epoxy to Daphnia magna. Environ Sci Pollut Res. 2012;19(5):1763–72.

7. Seltenrich N. A hard nut to crack. Environ Health Perspect. 2015;123(7).

8. Mortensen C. Biobased and Degradable Plastics in California [Internet]. Sacramento, CA; 2014. Available from: http://www.calrecycle.ca.gov/Publications/Documents/1498\20141498.pdf

9. Simoneau C, Van den Eede L and VS. Identification and quantification of the migration of chemicals from plastic baby bottles used as substitutes for polycarbonate. Food Addit Contam A. 2012;29:469–80.

10. USEPA. Advancing Sustainable Materials Management: Facts and Figures 2013 [Internet]. EPA530-R-15-002. 2015. Available from: http://www.epa.gov/epawaste/nonhaz/municipal/pubs/2013\_advncng\_smm\_rpt.pdf

11. ASTM. Standard Specification for Labeling of Plastics Designed to be Aerobically Composted in Municipal or Industrial Facilities [Internet]. 2012. Available from: www.astm.org

12. CMORE. Marine Debris Biodegradation Time Line [Internet]. Center for microbial oceanography research and education. 2008. Available from: http://cmore.soest.hawaii.edu/cruises/super/biodegradation.htm