Formal Recommendation
From: National Organic Standards Board (NOSB)
To: the National Organic Program (NOP)

Date: April 26, 2019

Subject: Pullulan

NOSB Chair: Harriet Behar

The NOSB hereby recommends to the NOP the following:
Rulemaking Action: Yes

Statement of the Recommendation:
The NOSB recommends the addition of Pullulan to the National List at §205.605(a) as an allowed non-agricultural, non-synthetic ingredient used in tablets and capsules for dietary supplements labeled "made with organic".

Rationale Supporting Recommendation (including consistency with OFPA and Organic Regulations):

Since the release in late 2016 of the NOP's Classification of Materials guidance document (NOP 5033), certifying agents are in general agreement that pullulan should be classified as a non-agricultural and non-synthetic substance. Under this classification, pullulan would need to appear on the National List in order for it to be included in made with organic products. There are no other NOP compliant vegetarian options available for producing organic encapsulated supplements. The only alternative practice for supplement manufacturers would be to use gelatin capsules, however gelatin is problematic for consumers looking for a vegetarian, kosher or halal product. Pullulan is completely biodegradable and does not pose risks to human health or the environment.

NOSB Vote:

Classification Motion:
Motion to classify pullulan as nonagricultural, nonsynthetic
Motion by: Lisa de Lima
Seconded by: Steve Ela
Yes: 14 No: 0 Abstain: 0 Absent: 0 Recuse: 0

Listing Motion:
Motion to add pullulan at §205.605(a) for use only in tablets and capsules for dietary supplements labeled "made with organic (specified ingredients or food group(s))."
Motion by: Lisa de Lima
Seconded by: Scott Rice
Yes: 14 No: 0 Abstain: 0 Absent: 0 Recuse: 0

Motion Passed

National Organic Standards Board
Handling Subcommittee
Petitioned Material Proposal
Pullulan
November 20, 2018

Summary of Petition:
A petition has been submitted to add Pullulan to the National List at §205.605(a) as an allowed non-agricultural, non-synthetic ingredient used in tablets and capsules for dietary supplements labeled "made with organic". The petition was submitted by the Organic Trade Association (OTA) on behalf of its National List Innovation Working Group. The OTA states that the purpose of the petition is two-fold: to protect the continued production and availability of USDA-NOP certified dietary supplements and to support the commercial development of certified organic pullulan.

For dietary supplements, the capsule is considered an "ingredient" and must either be "certified organic" or made up of ingredients compliant with the National Organic Program's (NOP) National List of Allowed and Prohibited Substances. Since the early 2000s accredited certifying agents have classified pullulan as agricultural and it was allowed in encapsulated dietary supplements certified in the "made with organic" category. Since the release in late 2016 of the NOP's Classification of Materials guidance document (NOP 5033), certifying agents are in general agreement that pullulan should be classified as a non-agricultural and non-synthetic substance. Under this classification, pullulan would need to appear on the National List in order for it to be included in made with organic products.

There are no other NOP compliant vegetarian options available for producing organic encapsulated supplements. Organic pullulan is currently not commercially available in the United States. According to the petition, Capsugel is the owner of U.S. patents covering pullulan capsules, and they are in the process of developing organic pullulan.

The only alternative practice for supplement manufacturers would be to use gelatin capsules. Gelatin is listed at §205.606 of the National List, but its use is problematic for consumers looking for a vegetarian, kosher or halal product. Otherwise, to continue producing vegetarian organic compliant products manufacturers would have to surrender their organic certification. According to the petition, the 2018 forecast for pullulan capsules is approximately 2.5 billion capsules, and a conservative estimate of $10 per 30 count bottle would represent an economic value of over $825 million.

Summary of Review:
Based on information provided in the TR and petition, pullulan appears to be of low risk to the environment and human health both in its use and disposal. There are no alternative materials that would allow the continued production of certified "made with organic" vegetarian encapsulated dietary supplements. The Handling Subcommittee recommends adding pullulan to the National List.

In 2004, Capsugel submitted a petition to the NOSB to add pullulan to §205.605. The petition was put on hold and no recommendation was ever made. Nothing was found in the NOSB meeting minutes that would clarify why no recommendation was ever made. In April of 2018 the Handling Subcommittee found the petition for pullulan to be sufficient and requested a technical report (TR). While the technical report was in development, the HS put forward a Petitioned Material Discussion Document with the intent of gathering public comment and allowing for discussion by the full Board at the Fall 2018 NOSB meeting. A number of certifiers and manufacturers wrote in support of classifying pullulan

as a non-agricultural substance and placing it on the National List. The Accredited Certifiers Association also wrote in support and noted that their working group on pullulan found it a challenge to evaluate using the decision tree NOP 5033. However, they did agree that the most appropriate classification was non-agricultural, with most agreeing that classification happens at step 3 of the decision tree. Capsugel, the manufacturer of pullulan capsules commented that they are working on an organic version of their pullulan capsule. They estimated that as many as 115 of their customers would be impacted if pullulan was not listed. They currently have more than 460 customers globally who purchase their pullulan product and the U.S. represents approximately half of all sales.

The TR states that pullulan is not included in any international standards: Canada, CODEX, EEC, or Japan. This is because, unlike in the U.S, international standards don't consider dietary supplement capsules to be an ingredient.

Category 1: Classification

1. Substance is for: ___X____ **Handling** _____ **Livestock**

2. For HANDLING and LIVESTOCK use:
   a. Is the substance _____ **Agricultural** or ___X____ **Non-Agricultural?**
   Describe reasoning for this decision using NOP 5033-2 as a guide:

   The first step of the decision tree asks if the substance is a mineral or bacterial culture. No, its best described as a microbial metabolite that is isolated from culture medium or fermentation broth. Since the answer is no, proceed to Step 2.

   The second step asks if the substance is a microorganism or enzyme. No, it's a product of a microorganism. Since the answer is no, proceed to Step 3.

   The third step asks if the substance is a crop or livestock product or derived from crops or livestock. No, it's derived from a microorganism using a crop material as the substrate. Since the answer is no, this results in a nonagricultural classification.

   Additionally, according to the TR (lines 291-294): If one considers that pullulan is derived from the microorganism that produces it, rather than from the agricultural substrates used to cultivate the microorganism, the conclusion is that pullulan is nonagricultural. Historic NOSB decisions on similar carbohydrate polymer substances (gums) currently on the National List are consistent with classification of pullulan as a nonagricultural substance.

   b. If the substance is **Non-agricultural**, is the substance __X___ **Non-synthetic** or ____ **Synthetic?**
   Is the substance formulated or manufactured by a process that chemically changes a substance extracted from naturally occurring plant, animal, or mineral sources? [OFPA §6502(21)] If so, describe, using NOP 5033-1 as a guide:

   According to the TR (lines 227 – 253) the petitioned pullulan is produced using steps 1-7 below. The process doesn't modify the extracted pullulan and no solvent residues persist in the finished material. Once pullulan is created/produced in the fermentation process (Step 1), it does not

undergo any further chemical change during either of the manufacturing processes described above. If chemically changed, the substance would no longer be considered pullulan per the JECFA monograph (JECFA 2011) or Food Chemical Codex (U.S. Pharmacopeia 2010). Additionally, the TR stated that no sources were found that indicate the existence of a chemically synthesized form.

The petitioned pullulan is produced using the following steps.

1. Fermentation of saccharide substrate by a microorganism creates pullulan.
2. Microfiltration separates microorganism cells and cellular debris from the aqueous medium containing water-soluble pullulan.
3. Heat-sterilization inactivates the heat-labile enzyme pullulanase, a co-product of the fermentation which causes the degradation of pullulan. This step also ensures the microbiological safety of the pullulan solution.
4. Deionization using insoluble ion exchange resins removes electrolytes and other nutrients, such as minerals, from the pullulan solution, thereby purifying it.
5. Intermediate concentration (water evaporation) increases the pullulan concentration in the solution.
6. Decolorization with activated carbon binds the black pigment melanin produced by the microorganism during the fermentation.
7. Filtration removes the activated carbon and adsorbed melanin.
8. Drying removes the water and yields a solid material.

3. For **LIVESTOCK**: Reference to appropriate OFPA category
   Is the substance used in production, and does it contain an active synthetic ingredient in the following categories: [§6517(c)(1)(B)(i)]; copper and sulfur compounds; toxins derived from bacteria; pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins and minerals; livestock parasiticides and medicines and production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleansers; or (ii) is used in production and contains synthetic inert ingredients that are not classified by the Administrator of the Environmental Protection Agency as inerts of toxicological concern?
   N/A

Category 2: Adverse Impacts

1. What is the potential for the substance to have detrimental chemical interactions with other materials used in organic farming systems? [§6518(m)(1)]

   Pullulan is not being petitioned to be used in organic crop production. Additionally, according to the TR it is completely biodegradable (TR lines 420-431)

2. What is the toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment? [§6518(m)(2)]

   Pullulan is completely biodegradable (Farris et al. 2014). It may be digested directly to glucose by the consumer, fermented by the intestinal flora, or broken down by microflora digesting human waste in a sewage treatment plant. In all cases, the carbon, oxygen, and hydrogen that constitute pullulan are converted to carbon dioxide, water, and sometimes hydrogen gas (produced in the colon).

Each byproduct of the production of pullulan is either biodegradable (the carbohydrate and nitrogen in the cell debris from the microorganism), recyclable (the ion exchange resin), biologically available (the mineral elements), or soil-compatible (activated charcoal). Thus, no harm to the environment or biodiversity is expected from the manufacture or use of pullulan as petitioned (TR lines 420-431).

3. Describe the probability of environmental contamination during manufacture, use, misuse or disposal of such substance? [§6518(m)(3)]

   Pullulan is completely biodegradable (Farris et al. 2014). It may be digested directly to glucose by the consumer, fermented by the intestinal flora, or broken down by microflora digesting human waste in a sewage treatment plant. In all cases, the carbon, oxygen, and hydrogen that constitute pullulan are converted to carbon dioxide, water, and sometimes hydrogen gas (produced in the colon).

   Each byproduct of the production of pullulan is either biodegradable (the carbohydrate and nitrogen in the cell debris from the microorganism), recyclable (the ion exchange resin), biologically available (the mineral elements), or soil-compatible (activated charcoal). Thus, no harm to the environment or biodiversity is expected from the manufacture or use of pullulan as petitioned (TR lines 420-431)

   Additionally, according to the petition, pullulan can be used as a base material in novel flocculants developed to remove contaminants in waste waters (Chimici & Constantin, 2001).

4. Discuss the effect of the substance on human health. [§6517 (c)(1)(A)(i); §6517 (c)(2)(A)(i); §6518(m)(4)].

   According to the TR evaluation questions #7 & #10, the only adverse effect on human health is flatus as a result of undigested carbohydrates entering the colon. This affect was found at high amounts of pullulan (10-50 grams), compared to the 63 milligrams found in medium sized vegetarian capsules. Pullulan can be considered a “resistant starch” that acts as a source of dietary fiber.

5. Discuss any effects the substance may have on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock. [§6518(m)(5)]

   Pullulan is not being petitioned to be used in organic crop production. Additionally, according to the TR it is completely biodegradable (TR lines 420-431)

6. Are there any adverse impacts on biodiversity? (§205.200)

   No adverse impacts were raised in the TR. No harm to the environment or biodiversity is expected from the manufacture or use of pullulan.

Category 3: Alternatives/Compatibility

1. Are there alternatives to using the substance? Evaluate alternative practices as well as non-synthetic and synthetic available materials. [§6518(m)(6)]

There are no NOP compliant vegetarian options available. Organic pullulan is currently not commercially available in the United States. Capsugel, the owner of US patents covering pullulan capsules, is in the process of developing organic pullulan.

The only alternative practice for supplements manufacturers would be to use gelatin capsules. Gelatin is listed on 205.606 of the National List, but its use would be problematic for consumers looking for a vegetarian, kosher or halal product.

Hydroxypropyl methylcellulose (HPMC) based capsules are commonly used as a vegetarian alternative to gelatin capsules. However, HPMC was petitioned to the National List in September 2002 and was not recommended by the Board for inclusion on the National List. The material was classified as synthetic and found not to be compatible with organic production.

2. **For Livestock substances, and Nonsynthetic substances used in Handling**: In balancing the responses to the criteria above, is the substance compatible with a system of sustainable agriculture? [§6518(m)(7)]

Category 4: Additional criteria for synthetic substances used in Handling (does not apply to nonsynthetic or agricultural substances used in organic handling): **NA**

Describe how the petitioned substance meets or fails to meet each numbered criterion.

1. The substance cannot be produced from a natural source and there are no organic substitutes; (§205.600(b)(1))

2. The substance's manufacture, use, and disposal do not have adverse effects on the environment and are done in a manner compatible with organic handling; (§205.600(b)(2))

3. The nutritional quality of the food is maintained when the substance is used, and the substance, itself, or its breakdown products do not have an adverse effect on human health as defined by applicable Federal regulations; (§205.600(b)(3)

4. The substance's primary use is not as a preservative or to recreate or improve flavors, colors, textures, or nutritive value lost during processing, except where the replacement of nutrients is required by law; (§205.600(b)(4))

5. The substance is listed as generally recognized as safe (GRAS) by the Food and Drug Administration (FDA) when used in accordance with FDA's good manufacturing practices (GMP) and contains no residues of heavy metals or other contaminants in excess of tolerances set by FDA; (§205.600(b)(5))

6. The substance is essential for the handling of organically produced agricultural products. (§205.600(b)(6))
7. In balancing the responses to the criteria in Categories 2, 3 and 4, is the substance compatible with a system of sustainable agriculture [§6518(m)(7)] and compatible with organic handling? (see NOSB Recommendation, Compatibility with Organic Production and Handling, April 2004)

Category 5: Additional criteria for <u>agricultural</u> substances used in Handling (review of commercial unavailability of organic sources): **NA**

1. Is the comparative description as to why the non-organic form of the material /substance is necessary for use in organic handling provided?

2. Does the current and historical industry information, research, or evidence provided explain how or why the material /substance cannot be obtained organically in the appropriate **<u>form</u>** to fulfill an essential function in a system of organic handling?

3. Does the current and historical industry information, research, or evidence provided explain how or why the material /substance cannot be obtained organically in the appropriate **<u>quality</u>** to fulfill an essential function in a system of organic handling?

4. Does the current and historical industry information, research, or evidence provided explain how or why the material /substance cannot be obtained organically in the appropriate **<u>quantity</u>** to fulfill an essential function in a system of organic handling?

5. Does the industry information about unavailability include (but is not limited to) the following: Regions of production (including factors such as climate and number of regions);
    a. Number of suppliers and amount produced;

    b. Current and historical supplies related to weather events such as hurricanes, floods, and droughts that may temporarily halt production or destroy crops or supplies;

    c. Trade-related issues such as evidence of hoarding, war, trade barriers, or civil unrest that may temporarily restrict supplies; or

    d. Other issues which may present a challenge to a consistent supply?

6. In balancing the responses to the criteria in Categories 2, 3 and 5, is the substance compatible with a system of sustainable agriculture [§6518(m)(7)] and compatible with organic handling? (see NOSB Recommendation, Compatibility with Organic Production and Handling, April 2004)

Classification Motion:

Motion to classify pullulan as nonagricultural, nonsynthetic
Motion by: Lisa de Lima
Seconded by: Steve Ela
Yes: 6 No: 0 Abstain: 0 Absent: 1 Recuse: 0

National List Motion:

Motion to add pullulan , at §205.605(a) for use only in tablets and capsules for dietary supplements labeled “made with organic (specified ingredients or food group(s)).”
Motion by: Lisa de Lima
Seconded by: Scott Rice
Yes: 6 No: 0 Abstain: 0 Absent: 1 Recuse: 0

Approved by Asa Bradman, Subcommittee Chair, to transmit to NOSB, February 24, 2019