The GC3 Collaborative Innovation Project on Preservatives: Outcomes, Learnings, and What's Next

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GC3 Innovators Roundtable - May 8 - 10, 2018

GREEN CHEMISTRY & COMMERCE COUNCIL
Business Mainstreaming Green Chemistry

GC3 Preservatives Project

Goals

1. Raise awareness, interest, activity and funding globally in industry, academia, and government for R&D, commercialization and scale of novel, safe and effective preservative technologies

2. To expand the palette of safe and effective preservatives for personal care and household products

The need for preservatives

Water-based consumer products require preservation

Preservatives prevent:

- Growth of bacteria, yeast, and mold
- Odor issues
- Product performance
- Pathogens

The need for new preservative technologies

- Regulatory restrictions; consumer, NGO, and retailer pressure have reduced the current palette of safe and effective preservatives available to formulators
- Too few effective preservatives used in products can increase sensitization and allergic reactions
- Formulators are seeking new, safe, and effective preservatives systems for use in their products to meet the diverse needs of their customers and other stakeholders

EU Cosmetics Regulation / Annex V
List of allowed preservatives

schülke

1	Benzoic acid, its salts and esters
2	Propionic acid and its salts
3	Salicylic acid and its salts
4	Sorbic acid (hexa-2,4-dienoic acid) and its salts
5	Formaldehyde
7	Biphenyl-2-ol (o-phenylphenol) and its salts
8	Zinc pyrithione
9	Inorganic sulphites and hydrogen-suphites
11	Chlorobutanol
12	Methylparaben, Ethylparaben
12	Propylparaben, Butylparaben
13	Dehydroacetic acid and its salts
14	Formic acid and its sodium salt
15	Dibromohexamidine and its salts (including isethionate)
16	Thiomersal
17	Phenylmercuric salts (incl. borate)
18	Undecylenic acid and salts
19	Hexetidine
20	5-Bromo-5-nitro-1,3-dioxane
21	Bronopol
22	Dichlorobenzyl Alcohol
23	Triclocarban
24	4-Chloro-m-cresol
25	Triclosan
26	Chloroxylenol
27	Imidazolidinyl Urea
28	Polyaminopropyl Biguanide
29	Phenoxyethanol
30	Methenamine
31	Quaternium-15
32	Climbazole
33	DMDM-Hydantoin
34	Benzyl alcohol
35	Piroctone Olamine
37	Bromochlorophen
38	o-Cymen-5-ol
39	Methylchloroisothiazolinone / Methylisothiazolinone (CMI/MI)
40	Chlorophene
41	Chloroacetamide
42	Chlorhexidine and its digluconate, diacetate and dihydrochloride
43	Phenoxyisopropanol
44	Behentrimonium chloride, cetrimonium bromide, cetrimonium chloride, laurtrimonium bromide, laurtrimonium chloride, steartrimonium bromide, steartrimonium chloride
45	Dimethyl Oxazolidine
46	Diazolidinyl Urea
47	Hexamidine, Hexamidine diisethionate, Hexamidine paraben
48	Glutaraldehyde
49	7-Ethylbicyclooxazolidine
50	Chlorphenesin
51	Sodium Hydroxymethylglycinate
52	Silver chloride
53	Benzethonium Chloride
54	Benzalkonium Chloride
55	Benzylhemiformal
56	Iodopropynyl Butylcarbamate
57	Methylisothiazolinone
58	Ethyl Lauroyl Arginate HCl
59	Citric Acid and Silver Citrate

Market demands

schülke

- **Free-of List (No-No List)**
- No formaldehyde donors
- No halogenated materials
- No isothiazolinones
- No long-chain parabens
- No CMR substances
- No allergenic compounds
- No aromatic compounds
- No warnings on the final product
- No substances which cannot be used for children under the age of 3 years

EU Cosmetics Regulation / Annex V
List of allowed preservatives

schülke

2	Propionic acid and its salts
4	Sorbic acid (hexa-2,4-dienoic acid) and its salts
9	Inorganic sulphites and hydrogen-suphites
13	Dehydroacetic acid and its salts
18	Undecylenic acid and salts

35	Piroctone Olamine

44	Behentrimonium chloride, cetrimonium bromide, cetrimonium chloride, laurtrimonium bromide, laurtrimonium chloride, steartrimonium bromide, steartrimonium chloride
52	Silver chloride
58	Ethyl Lauroyl Arginate HCl
59	Citric Acid and Silver Citrate

GC3 Collaborative Technology Criteria

GC3 GREEN CHEMISTRY & COMMERCE COUNCIL
Business Mainstreaming Green Chemistry

Need Statement & Development Criteria for New Preservatives for Personal Care & Household Products

Developed by the Green Chemistry & Commerce Council (GC3) with contributions from:

Aubrey Organics	Colgate-Palmolive	Method
Aveda	Henkel	Procter & Gamble
BabyGanics	Johnson & Johnson	Seventh Generation
Beautycounter	L'Oreal	Unilever

Version 1.0

GC3

GC3 Need Statement & Development Criteria for New Preservatives for Personal Care & Household Products

	GENERAL CRITERIA (For Personal Care, Household, and Natural/Organic Products)	ADDITIONAL WANTS
1. Performance		
Activity	Broad spectrum activity: gram-positive & gram-negative bacteria, yeast & mold	Not likely to build microbial resist
	In formulation, at use levels, meets preservative challenge test acceptance criteria (e.g., USP 51, CTFA M-3, or similar)	
	Low number of ingredients needed to get broad spectrum activity (ideally 1 - 3 ingredients)	
pH Activity	pH 5 – 8	pH 5 – 10, best is pH 2 – 11
Shelf Life in Formulated Product	Shelf life of 2 years	Shelf life of 3 years
	Can withstand freeze/thaw	Stable from 25 to 50°C
		UV stable for 3 months in packag

Articulates the need for new preservatives

Provides a set of detailed development criteria for new preservatives, including:

- **Performance**
- **Regulatory**
- **Human health**
- **Environment**
- **Business factors**

http://greenchemistryandcommerce.org/projects/preservatives-project

Collaborative Preservatives Challenge

Approach

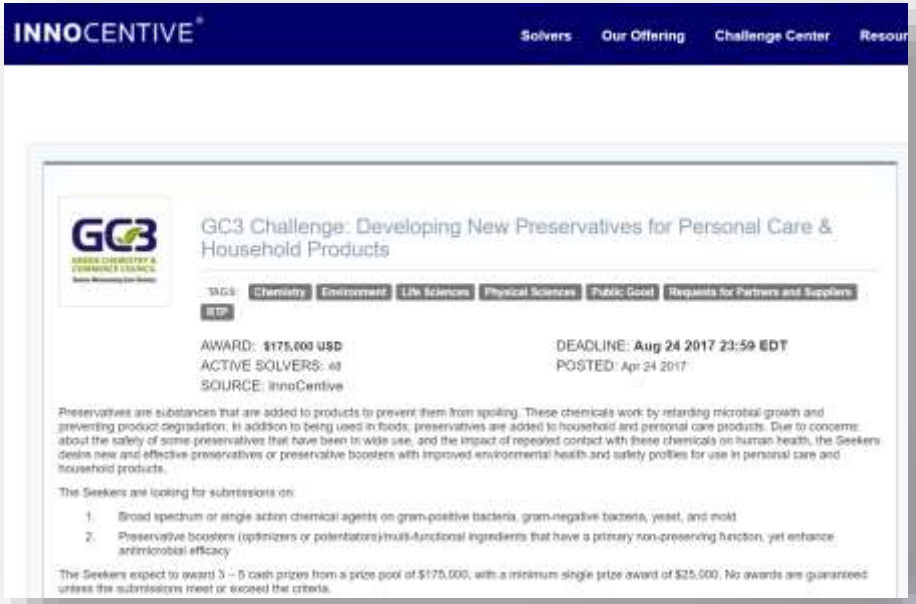
- Sought to identify a large and diverse pool of novel:
  - Ideas - white papers
  - Early stage technologies - proof-of-concept
  - More mature technologies, perhaps used in other domains
  - From small companies, startups, universities, and individuals with promising ideas or technologies
- Facilitate partnerships with strategics for evaluation, development, investment, commercialization & scale

Collaborative Preservatives Challenge

Approach

Partnered with **INNO**CENTIVE®

- Administrative, legal and fiscal agent
- Spearheaded design & execution of the Challenge



Collaborative Preservatives Challenge

Approach

2 Categories of Sponsorship & Participation:

Category 1 Sponsors: CPG companies, 1 retailer and other stakeholders, N=14

- Designed the challenge, e.g., technical and safety criteria
- Judged the submissions, based on their needs and experience using and evaluating preservatives for their products
- Potential development partners

Category 2 Sponsors: Preservative Suppliers: N=5

- Potential development, commercialization and scaling partners
- Given all 48 submissions after judging
- Given safety assessments and performance test results
- Given detailed results of judging by Category 1 Sponsors

GC3 Preservative Challenge Sponsors

CPG Companies

Babyganics

Beautycounter

Beiersdorf

Colgate-Palmolive

J&J

Kao USA

Method

P&G

RB

SC Johnson

Unilever

Retailers

Target

Walmart

Preservative Suppliers

Dow

Lonza

Schuelke

Symrise

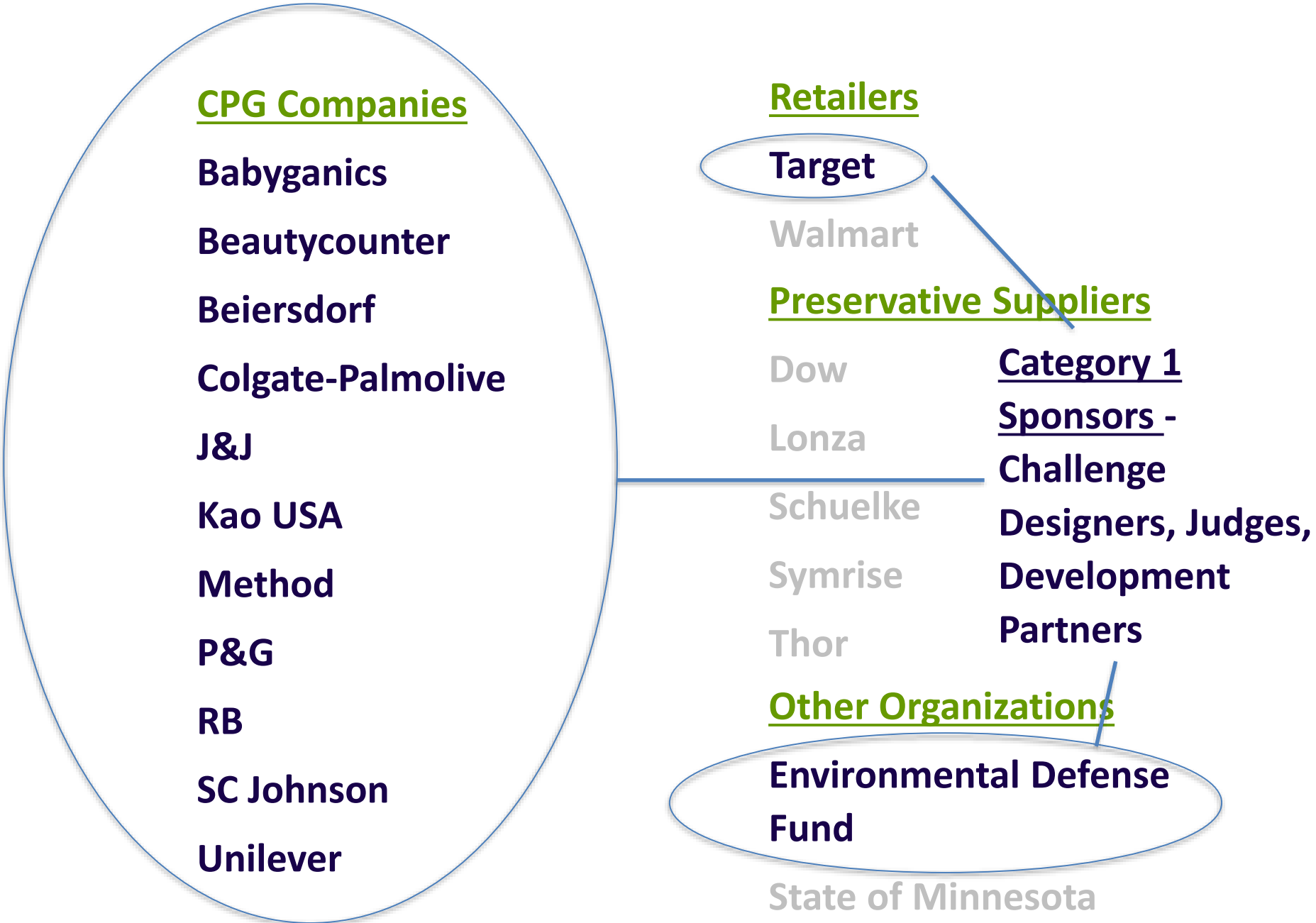
Thor

Other Organizations

Environmental Defense Fund

State of Minnesota

GC3 Preservative Challenge Sponsors



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Category 2 Sponsors - Potential Development, Commercialization and Scaling Partners

Other Organizations

Environmental Defense Fund

State of Minnesota

Collaborative Preservatives Challenge

Approach (cont.)

- Awards for “Solvers”
  - $175,000 prize pool
  - Received feedback from judging
  - Received results from safety assessment and performance evaluation
  - Received visibility and opportunities to partner with formulators and suppliers for evaluation, joint development, investment, licensing, etc. to bring to market & scale
  - Retain their IP

Collaborative Preservatives Challenge

Approach

- Yesterday: Final Event – 7 Semi-Finalists + Sponsors
  (48 total submissions received)
- Winners will be selected in June
- Going Forward: One-on-one discussions with solvers, suppliers and CPG companies

Judging

48 Submissions

First Round of Judging

First Round of Judging

Submission	XYX			ABC				LMNOP		
	28			29				30		
Judges	HS2	M2	F3	M5	HS3	F3	M4	HS2	M2	F6
Main Requirements:										
Activity on at least one of the following: a. Gram-negative bacteria b. Gram-positive bacteria c. Mold d. Yeast	N/A activity is just asserted, no empircal	+	N/A	+ all 4 groups	+ data to support	+ all 4 groups	+ Hand soap formulation	+ Did not test for antifungal or antiviral	+	+
Active within the pH range of 5 to 8	N/A suggested, no empircal data is provided	+	N/A	+	+ data to support	+	N/A	- no info/data provided	N/A	NA
Maintain shelf life of a formulated product for 2 years	- no	N/A	N/A	+	+	+	N/A	- no	N/A	NA
Can withstand multiple freeze/thaw cycles	- no	N/A	N/A	N/A statement	+	N/A	N/A	- no	N/A	NA
Effective in use at a concentration of less than 2%	- no info/data provided	+	N/A	+	+	+	N/A	- no info/data provided	N/A MIC only	+ Indicates low MIC

Judging

48 Submissions

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First Round of Judging

⇩

10 assessed for safety

Plant Extract	Chitosan	Bark Extract	Plant Extract	Bark Extract	Monoterpenoid Phenol	Bio-derived Chemistry	2 Part Reversible Complex	Chitosan	Amino Acid Chemistries
9	18A	19	22	24	29	35	38	46	65

Safety Assessment

Endpoint	Preservative XYZ	Analog A
Persistence	Readily biodegradable[a]	-
Bioaccumulation	Not estimated to be bioaccumulative	-
Aquatic toxicity	GHS Category Acute 3 (daphnia and algae)[a]	GHS Category Acute 2 (fish); GHS Category Acute 2-3 (daphnia and algae)
Acute mammalian toxicity	GHS Category 4 (oral toxicity)[b]	GHS Category 4 (oral and dermal)
Systemic toxicity	Low concern for systemic toxicity[b]	Low concern for systemic toxicity
Reproductive and Developmental	Low concern for reproductive and developmental toxicity[b]	Low concern for developmental toxicity
Genotoxicity	Low concern for genotoxicity[b]	Low concern for genotoxicity
Carcinogenicity	No data	No data
Dermal irritation	Not irritating or corrosive to skin[b]	GHS Category 2 (Irritant)
Eye irritation	Not irritating to eyes[b]	GHS Category 2 (Reversible effects on the eye)
Skin sensitization	Not a skin sensitizer[b]	Not a skin sensitizer

"-" Not evaluated; [a] Full study report provided by the solver; [b] Based on summary results provided by the solver; [c] Based on estimates performed by SRC.

Judging

48 Submissions

First Round of Judging

10 assessed for safety

Plant Extract	Chitosan	Bark Extract	Plant Extract	Bark Extract	Monoterpenoid Phenol	Bio-derived Chemistry	2 Part Reversible Complex	Chitosan	Amino Acid Chemistries
9	18A	19	22	24	29	35	38	46	65

7 assessed for performance: Stability and antimicrobial effectiveness

Performance Testing

Develop simple base formulations:

1. **Simple lotion**
2. **Simple Shampoo**
3. **Simple Dish Soap**

Cosmetech LABORATORIES, INC.

⇩

Stability Testing

⇩

PDA Laboratories, Inc.
A Contract Testing Laboratory

Anti-microbial effectiveness testing

Judging

48 Submissions

First Round of Judging

10 assessed for safety

Plant Extract	Chitosan	Bark Extract	Plant Extract	Bark Extract	Monoterpenoid Phenol	Bio-derived Chemistry	2 Part Reversible Complex	Chitosan	Small, Naturally Occuring Molecules
9	18A	19	22	24	29	35	38	46	65

7 assessed for performance: Stability and antimicrobial effectiveness

Final Event: May 7 - 7 Semi-Finalists

Final Judging - June

Winners Announced!

Results so Far

- 48 Submissions
- 7 Semi-Finalists with promising technology (some early stage) that passed first round of judging, safety screening and still undergoing performance testing
- CPG companies, suppliers, and “solvers” have started one-on-one discussions

Going Forward

- Continue to support the 7 Semi-Finalists in their pursuit of customers and development & commercialization partners
- Continue to support new innovators with promising preservative technology
- Continue to connect “solvers” with “seekers”
- Leverage “infrastructure” developed in the project

Why did the GC3 take on these projects on preservatives?

The GC3 saw the opportunity to:

- Address an important, common area of green chemistry need
- Bring together GC3 member companies to collaborate to seek solutions

Panelists

Homer Swei
Johnson & Johnson

Vanita Srinivasan
RB

Phil Hindley
Lonza

Irena Jevtov
Irena Jevtov Research & Innovation