

A UV Curable Grease Resistant Coating Comprised of GRAS Components

Why GRAS?

Food Contact Concerns

- FCN 772
- Requires Extractables
- Only Food Contact Alliance Members and Customers

Origin of an Idea

Although first explored in the 1930's, in the 1950's food irradiation research was growing under the "Atoms for Peace" program. The first petition for treatment of foods by irradiation was submitted in the 1960's. A task group established in 1981 concluded that studies with irradiated foods do not show adverse toxicological effects. Nonetheless, over the years there has been considerable concern over the effects of ionizing radiation on foodstuffs. A study in 2000 explored the structural changes, such as cross linking, induced in ovalbumin, ovomucoid, and ovotransferrin by the effect of oxygen radicals generated by gamma radiation.

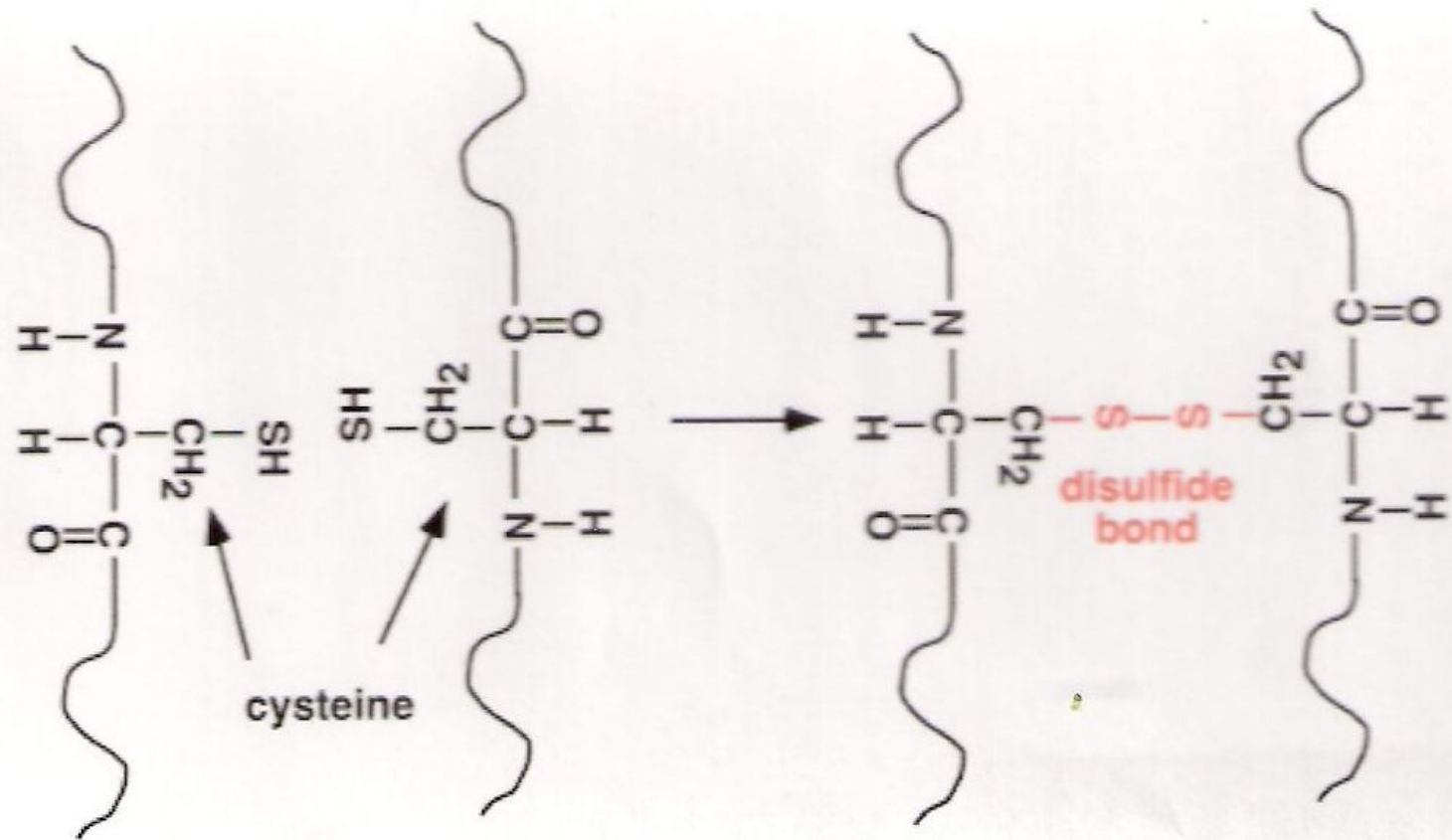
**Could Similar Changes be Induced
with UV?**

Cysteine

S-H bonds oxidize to S-S

Relaxation of protein helped by GRAS acid

- disulfide cross-linking



Grease Resistance

Protein

Starch

Gum

Vegetable Powder

Acid

Water

Application

Coatings were applied by draw down using either zero or # 3 bars. Curing was done at either 100 ft/min, 150 ft/min, or 200 ft/min using a 400 WPI Fusion lamp with an “H” type bulb.

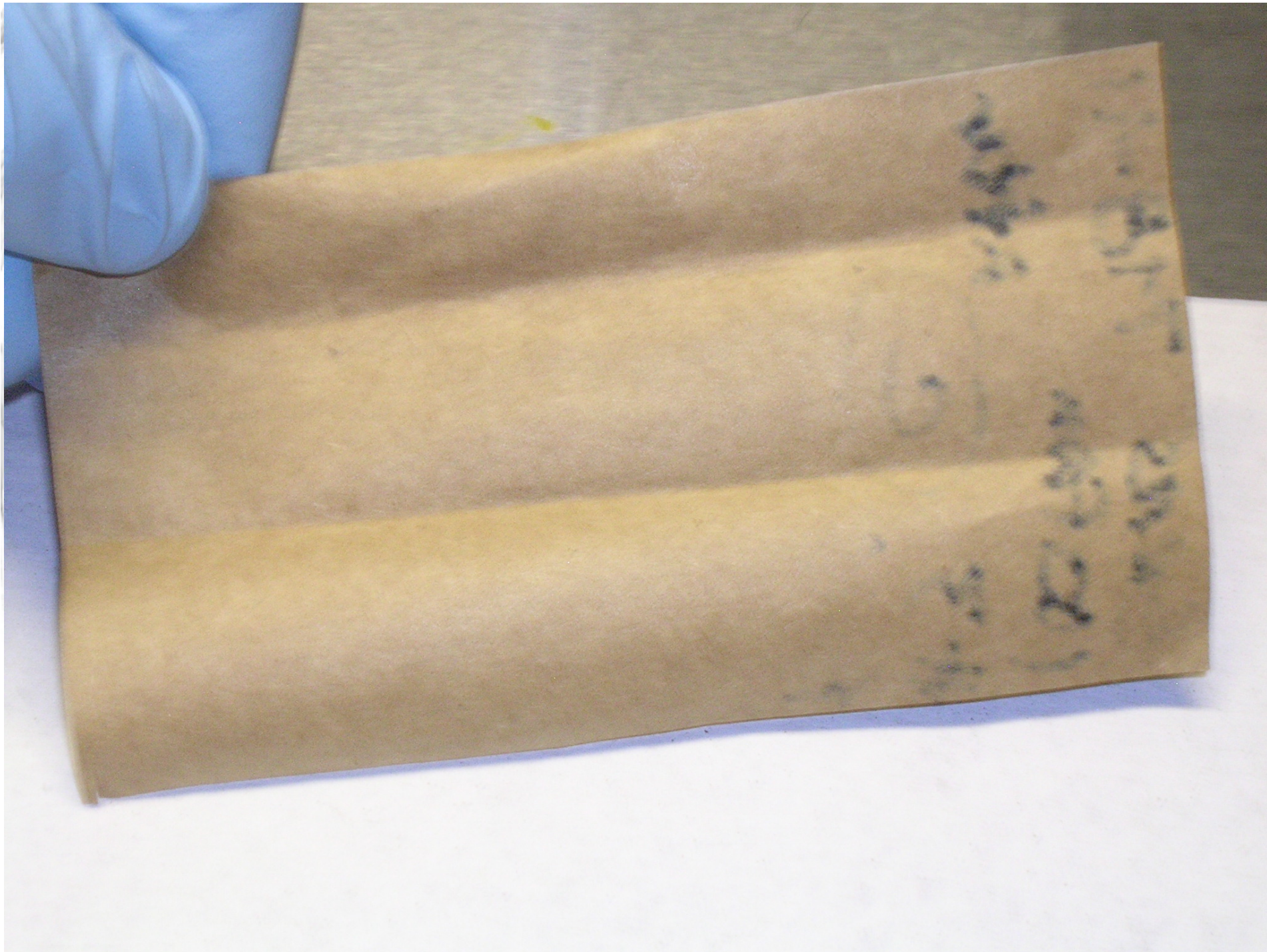
Coating	% Protein	% Vegetable Powder	% Xanthan Gum	% Water	% Starch	% Emulsifier	% Acid Salt
62011	18.86	1.2	3.08	76.5	0	0.51	0.34
62111	19.68	0	0.88	79.07	0	0	0.35
62111 #2	16.59	0	0.74	78.47	3.88	0	0.29
62211	19.14	0	0	75.09	5.39	0	0.37
62711	18.88	0	0	72.3	8.45	0	0.4
63011	27.32	0	0	58.48	13.66	0	0.53
70511	21.56	0	0	66.1	11.2	0	1.12
70711	20.69	0	0	64.78	13.44	0	1.07
71211	19.99	0	0	61.77	17.72	0	1.01
71811	19.2	0	0	60.59	19.2	0	0.99
71911	16.84	0	0	61.95	20.16	0	1.03
72611	16.05	0	0	59.8	23.34	0	0.79
80211	10.9	0	0	68	20.1	0	0.1
80511	11.27	0	0.86	65.07	21.9	0	0.86
81111	11.13	0	1.5	64.67	21.63	0	1.07
81611	9.76	0	1.12	65.85	22.51	0	0.75
83011	9.11	3.69	1.23	72.41	12.8	0	0.73
90611	6.82	3.28	0.76	78.03	10.6	0	0.51

Application

Peanut butter, 3 in 1 oil^(R), and canola oil were used as test reagents. These three substances were allowed to sit directly on a crease in the coated paper for 24 hours. Absorbent paper was placed beneath the test samples to detect penetration.

Coating	Canola Oil	3 in One™	Peanut Butter	Comments	Ratio Protein to Starch	Ratio Protein to Xanthan Gum
62011	F	F	F		N/A	6.12
62111	F	F	F		N/A	22.36
62111 #2	F	F	F	Lower odor peanut butter	4.28	21
62211	F	F	F	Slower penetration on Peanut Butter	3.55	N/A
62711	F	F	F	Less Penetration on Peanut Butter	2.23	N/A
63011	P	P	P	Spreading of oils on surface	2	N/A
70511	F	F	F	Only slight penetration overnight	1.93	N/A
70711	P	P	P	No penetration but some staining	1.54	N/A
71211	P	P	P	No penetration. No peanut butter stain.	1.13	N/A
71811	F	F	F	Slight penetration	1	
71911	P	P	P	Little or no penetration. No peanut butter stain	0.84	N/A
72611	F	F	F		0.69	N/A
80211	F	F	F		0.54	N/A
80511	F	F	F	Better than 80211. Peanut butter much better.	0.51	13.1
81111	F	F	P	Failures slight	0.51	7.42
81611	F	F	P	Failures very slight	0.43	8.71
83011	P	F	P	Failure slight	0.71	7.4
90611	P	P(# 3 bar)	P		0.64	8.97





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Abrasion Resistance

Samples of coatings were additionally tested for abrasion resistance using a Sutherland rub tester with a corrugated cardboard receptacle. Sutherland rubs were performed on some formulations using a Danilee Sutherland 2000 rub tester with a 4 lb weight and a speed setting of 2. A standard corrugated receptacle was used.. No liquids were added.

Coating	Sutherland Results
70711	One minor scratch when creased before coating with 0 bar. No damage when creased after coating with 0 bar. 3 bar coating showed damage.
71811	No damage with either bar.
71911	One small scratch
80211	Minor scratching
80511	Rub through when creased after coating. No damage when creased before coating.
81111	Rub through when creased after coating. Some scratching when creased before.
81611	No damage.
90611	2 mild scratches

Conclusions

- Grease resistant UV coatings may be formulated from GRAS components.
- Resistance is dependent on protein/starch ratio.
- Additions of xanthan gum and powdered vegetable contribute to grease resistance.
- Coatings show a high degree of abrasion resistance even when grease resistance is lower.

Further study may include optimization of parameters to maximize abrasion resistance.

THANK YOU!