Assessment of ATP Bioluminescence monitoring in restaurants

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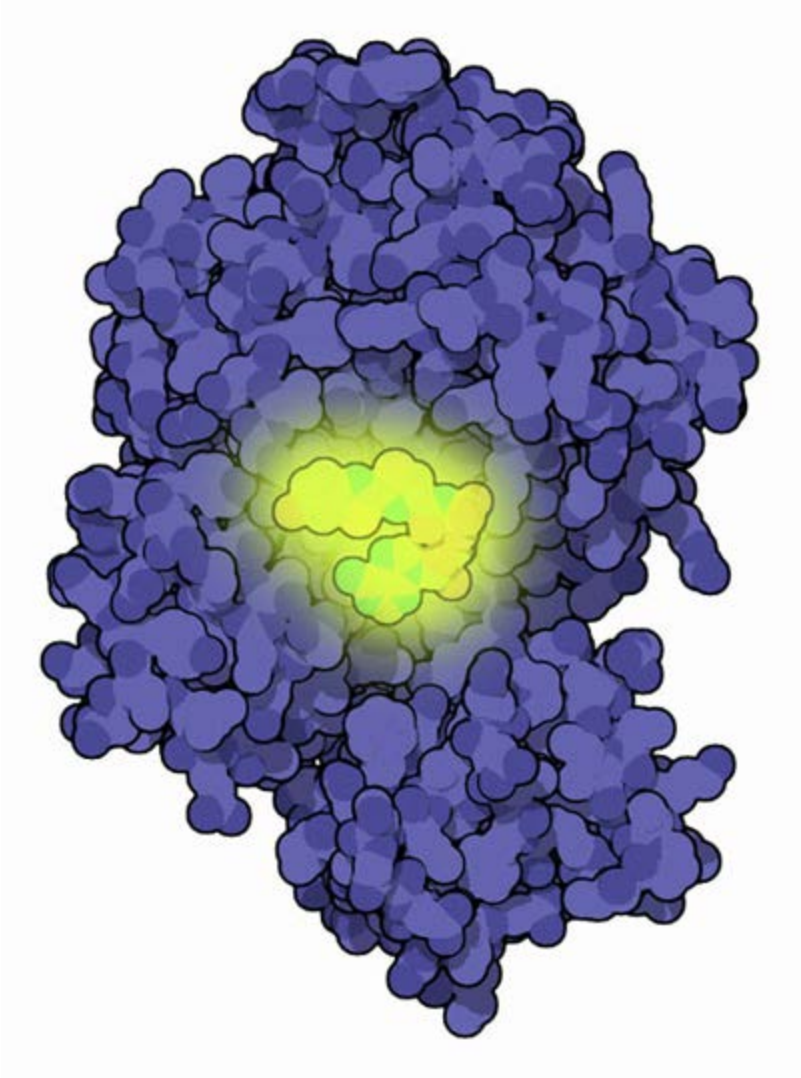
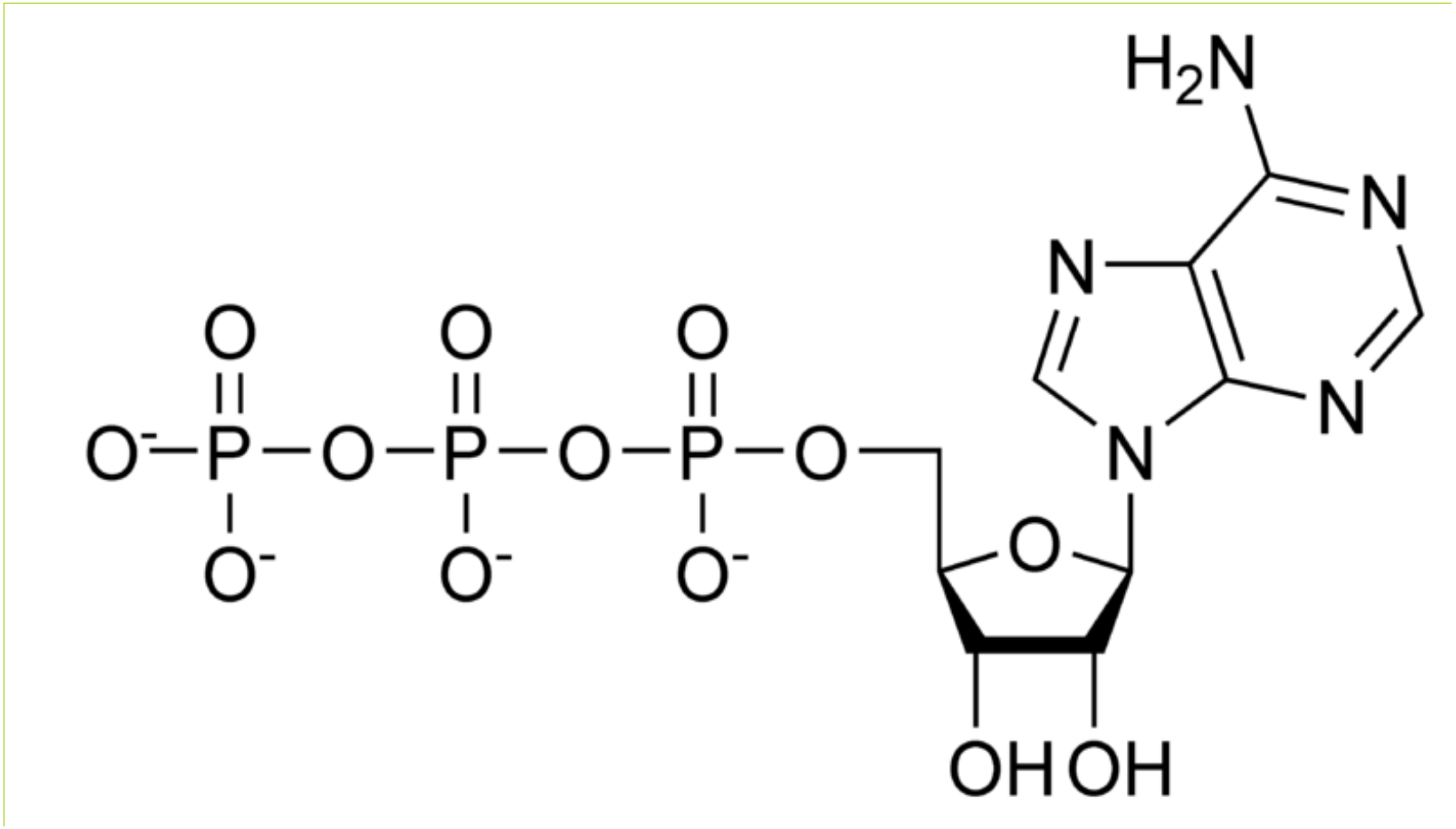
How fireflies produce light

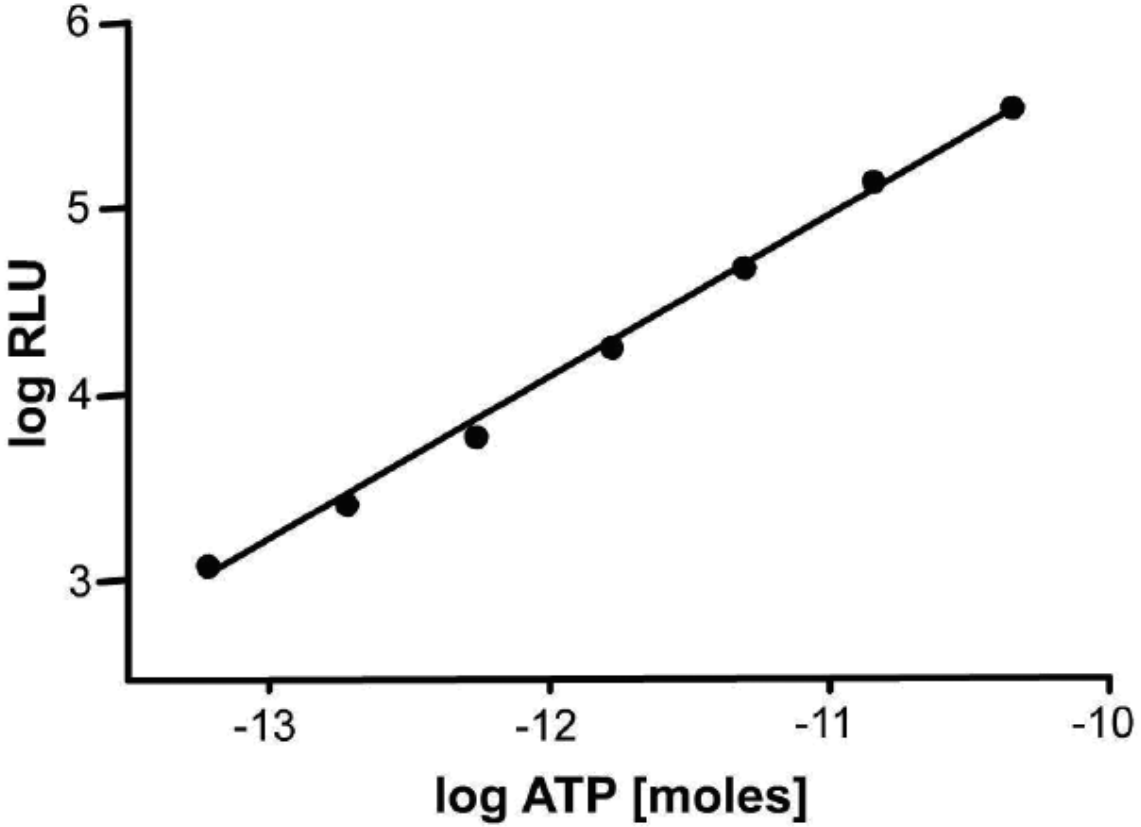


- Luciferase/luciferin
- Oxygen
- ATP

Adenosine Triphosphate (ATP)



Light proportional to ATP



ATP Bioluminescence test kits

- Collection
  - Single use swabs (cotton or foam)
  - ATP releasing agent
- ATP detection/quantification
  - Self-contained enzyme and co-factor
  - Luminometer
- Data handling

Available ATP kits

Manufacturer	Swab	Luminometer	Test time (s)
Biotrace	Clean-trace	Unilite NG	25
BioControl	Lightening MVP swab	Lightening MVP	25
Neogen	AccuClean	Accupoint	30
Merck	Hy-lite rinse pen	HY-Lite 2	45
Hygiena	UltraSnap	SystemSURE II	45
Charm	PocketSwab plus	Luminator-T	65

ATP vs. Micro testing

ATP	Microbiology
Results in minutes	Results in days
Assesses cleaning	Detects microbes
Simple	Complex
Inexpensive	Expensive

Concept

- Clean food contact surfaces
  - Little or no ATP
  - Easier to sanitize
  - Decreased microbial risk
- Unclean food contact surfaces
  - High levels of ATP
  - Harder to sanitize
  - Significant microbial risk

Cleaning standards for food contact surfaces (FCS)

- Goal
  - Remove organic matter
- FCS for PHF/TCS
  - As often as necessary
  - Once every four hours
- Related to temperature
- Clean to sight and touch

Temperature	Cleaning Frequency
5.0°C (41°F) or less	24 hours
>5.0°C - 7.2°C (>41°F - 45°F)	20 hours
>7.2°C - 10.0°C (>45°F - 50°F)	16 hours
>10.0°C - 12.8°C (>50°F - 55°F)	10 hours

Food Contact Surface (FCS)

(1) A surface of EQUIPMENT or a UTENSIL with which FOOD normally comes into contact; or

(2) A surface of EQUIPMENT or a UTENSIL from which FOOD may drain, drip, or splash:

(a) Into a FOOD, or

(b) Onto a surface normally in contact with FOOD.

2005 FDA Model Food Code

Transient microbes on FCS

- From raw materials
- Humans
- No history of establishment
- Controlled by routine cleaning and sanitizing
  - E.g. Shigella and Campylobacter

Retail outbreaks attributed to food contact surfaces

Product	Pathogen	Cause	References
Different foods	E. coli O157:H7	Contaminated grinder	Banatvala et al, 1996
Ice Cream	S. enteritidis	Ice cream mix in egg tanker	Hennessy et al, 1996
Salad dressing	S. potsdam	Prep. surface	Unicomb et al, 2003
Ground beef	S. typhimurium	Meat grinder	Roels et al, 1997

MDH study

- Pilot study to:
  - Assess utility of ATP testing
  - Determine failure rates of visibly clean FCS
  - Assess effect on failure of:
    - Menu
    - Method of warewashing
    - Type of equipment/utensils

Method

- Samples collected in selected restaurants
  - Based on menu
  - Willingness to participate
- Clean equipment and utensils sampled
  - Manufacturers instructions
  - Initial field trial
- Zig-zag swabbing (east/west and north/south)

Sample collection

FCS	Area swabbed
Cups	5 cm band on either side of the rim
Plates	Eating surface
Knives	
Forks	
Spoons	
Slicers	10 cm^2 area of blade
Boards	10 cm^2 area at center

Clean equipment/utensil

Equipment/utensils	Count
Cups	88
Plates	90
Knives	94
Forks	92
Spoons	93
Slicers	11
Boards	25
Total	**493**

Samples by warewashing method

Warewashing method	Number of samples
High temp machine	292
Low temp machine	158
Manual	43
Total	**493**

Samples by menu

Menu Type	**Number of samples**
American (13)	235
Asian (9)	80
Others (11)	178
Total	**493**

Pass/fail

- Hygiena instructions
  - ❖≤ 30 RLUs (clean)
  - ❖>30 and ≤ 300 RLUs (caution)
  - ❖>300 RLU (unclean)
- MDH study
  - ❖≤ 30 RLUs (pass)
  - ❖> 30 RLUs (fail)

Data analysis

- Summary statistics calculated for RLUs
- Pass/fail frequencies calculated
- Chi square significance
- Data analyzed with:
  - version 3.3.2 EpiInfo software
  - SAS Enterprise Guide 3

Results summary

- 137 out of 493 (28%) FCS failed
- Failure rates varied with surface
- Menu associated with failure
- Warewashing associated with failure
- Cutting boards and slicers worst
- Cups and plates were best

ATP results by surface type

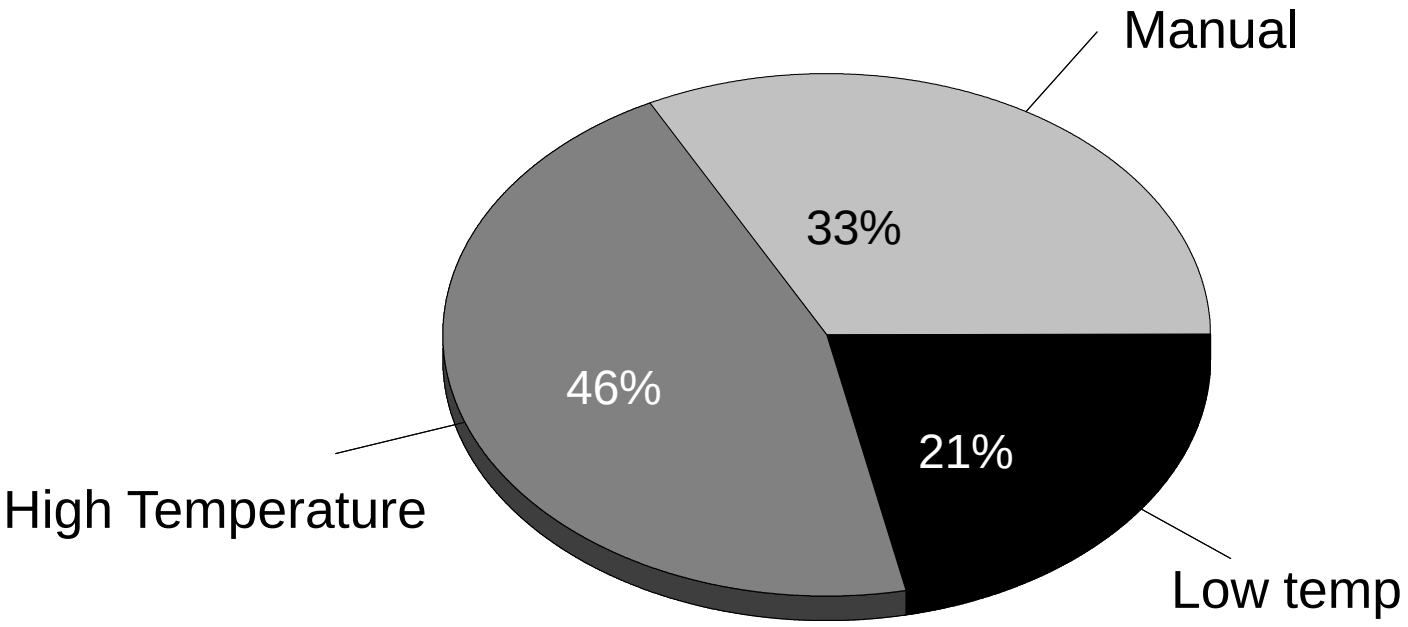
Food contact surface	Test result		% failing
	Pass	Fail	
Cups	79	9	10
Plates	69	21	23
Knives	65	29	31
Forks	63	29	32
Spoons	62	31	33
Slicers	6	5	46
Boards	12	13	52
Total	**356**	**137**	

ATP results by menu

Menu type	Test result		Percent failing
	Pass	**Fail**	
Others	138	40	23
American	168	67	29
Asian	50	30	38
Total	**356**	**137**	

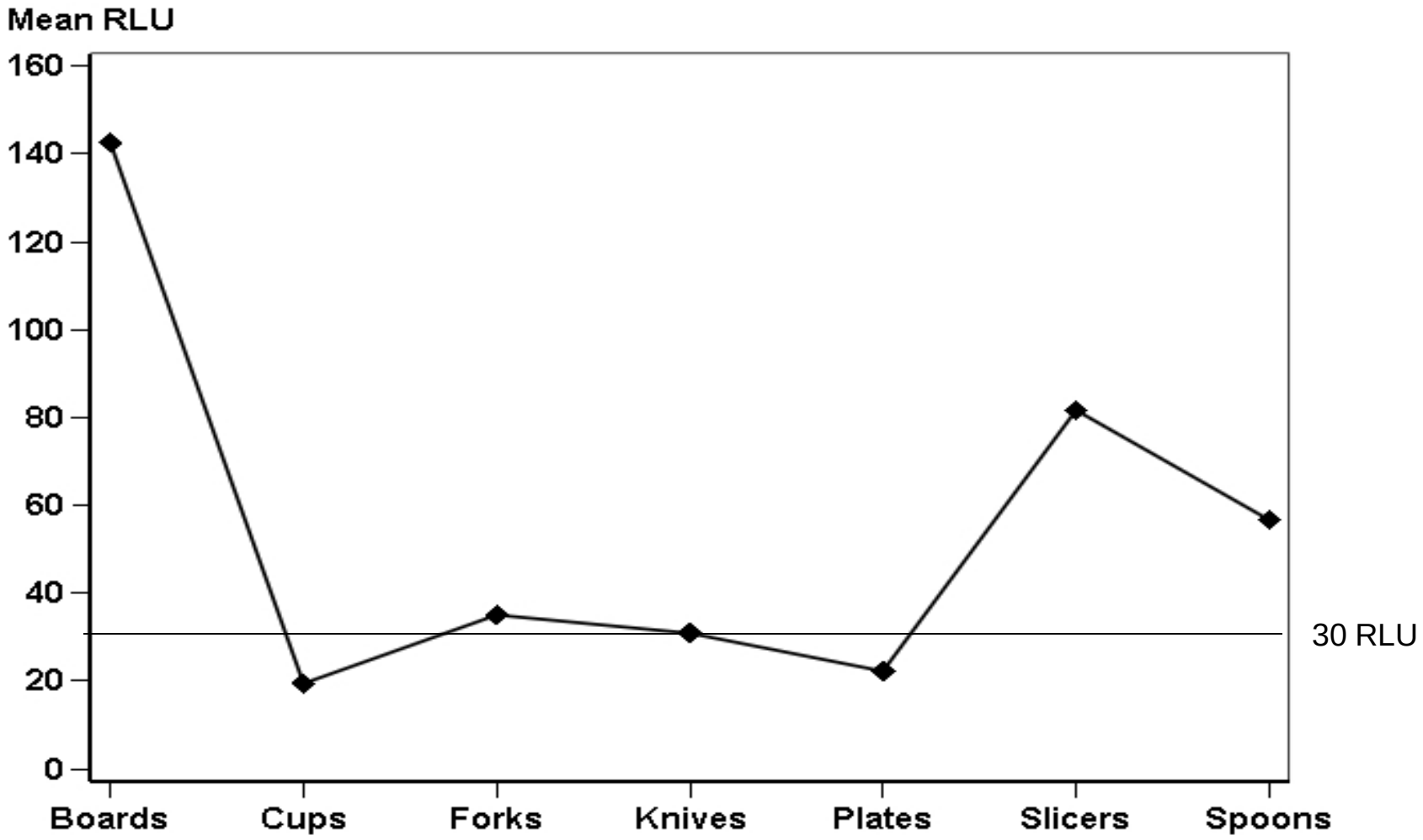
Chi-square 7.32; p-value 0.03

Failure rates by warewashing method



Chi-square 22.7; p-value < 0.0001

Mean RLU levels by FCS type



Discussion

- Monitoring FCS cleaning is beneficial
  - Assess food contamination risk
  - Identify problems with cleaning protocols
  - Training
- Cutting boards and slicers
  - Inadequate cleaning effort
  - Too hard to clean

Limitations/challenges

- Only one system tested
- Lack of background information
- Lack of standard plans for sampling
- ATP signal decay
- Pass/caution/fail criteria

ATP monitoring of FCS cleaning

- Why
  - Detect cleaning failure
  - Focus cleaning/training efforts
- Where
  - Sites with direct contact with RTE foods
  - Sites most likely to reflect cleaning failures
- How often
  - Based on knowledge of the operation
  - Economics

Acknowledgements

- MDH staff
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Failure rates by menu and type