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effect of food residue and surface material type

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UV- light in hygienic surface validation:
Effect of food residue and surface material type

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Introduction

•Presence of food residue post cleaning is indicative of poor hygiene on surfaces
•Use of UV-visible radiation have been shown useful as a surface hygiene assessment method;
  •Its cheap, real-time and reliable
•Data available is mainly in use on stainless steel
  •Use on other surface and their effect on observations has not been previously investigated

Objectives

•To investigate the use of UV-visible radiation for detecting residue on surfaces as a means of validating cleanliness

•To assess the effect of the surface type on the extent residue detection

Conclusions

•The surface materials being illuminated must taken into account in the choice of lamp wavelength
•The type of expected residue is also important in wavelength lamp choice
•Findings may serve as a guide during use of UV-illumination for real-time hygiene validation of surfaces

Materials and Methods

Wavelengths at 365, 395, 435, 445, 470 and 490 nm from a monochromator were used to illuminate residues of beef, chicken, apple, mango and skim milk. These were on three surfaces: aluminium, a fibre plastic material (FRP) and stainless steel, pre- and post a cleaning step using commercial detergent. The area covered by residues as detected by specific wavelengths under a fluorescence microscope was compared statistically.

Fig 1. Material surfaces used in the study

Table 1: Average percentage area/cm² of abiotic surfaces covered with *apple* residue. Residue was exposed to surface for 10 min before draining and allowing to dry; cleaning was for 10 s using a commercial detergent. Images were by fluorescent microscopy with a monochromator providing UV illumination

Wavelength (nm)	[a]Aluminium		FRP		Stainless steel	
	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning
365	$^{b}6.2 \pm 4.2^{A}$	0.29 ± 0.23^{A}	18 ± 18^{A}	0.30 ± 0.41^{A}	4.5 ± 3.6^{A}	0.088 ± 0.066^{A}
395	7.9 ± 3.8^{A}	0.30 ± 0.19^{A}	24 ± 20^{A}	0.33 ± 0.27^{A}	5.6 ± 2.9^{A}	0.11 ± 0.056^{A}
435	8.2 ± 4.3^{A}	0.012 ± 0.014^{B}	24 ± 20^{A}	0.40 ± 0.34^{A}	5.8 ± 3.2^{A}	0.014 ± 0.036^{B}
445	5.3 ± 4.9^{A}	0.010 ± 0.018^{B}	23 ± 19^{A}	0.36 ± 0.33^{A}	5.4 ± 3.3^{A}	0.0080 ± 0.020^{B}
470	$4.3 \pm 5.2^{A,B}$	0.0010 ± 0.0030^{B}	21 ± 19^{A}	$0.13 \pm 0.18^{A,B}$	0.57 ± 1.1^{B}	0.0010 ± 0.0010^{B}
490	0.48 ± 0.23^{B}	0.0010 ± 0.0030^{B}	2.2 ± 4.1^{B}	0.0020 ± 0.0060^{B}	0.0080 ± 0.0090^{B}	0.0010 ± 0.0040^{B}

Table 2: Most suitable wavelength ranges for UV lamps to be used for detection of tested residue/abiotic surface. Values are wavelengths (nm), with optimum in parenthesis

Abiotic surfaces	Residues				
	Beef	Chicken	Apple	Mango	Skim milk
[a]Aluminium	365-445	435-490	395-435	365-445	365-445
	(395)	(435)	(395)	(395)	(395)
Fiber plastic material (FRP)	435-470	435-470	395-470	395-445	365-445
	(435)	(445)	(435)	(435)	(445)
Stainless steel	365-445	435-445	365-445	395-435	365-445
	(395)	(435)	(395)	(395)	(365)

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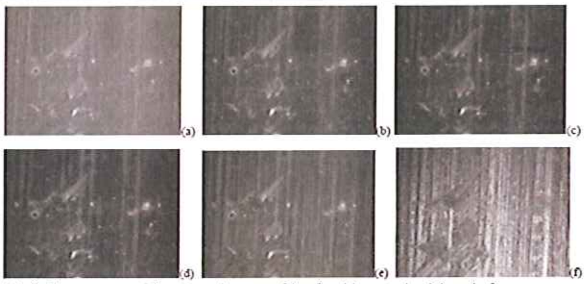

Fig 2: Fluorescence microscopy images of *beef* residue on aluminium, before application of washing step, as detected at various wavelengths from a monochromator; (a) 365 nm, (b) 395 nm, (c) 435 nm, (d) 445 nm, (e) 470 nm, (f) 490 nm. The significant differences in visible area with residue are evident.

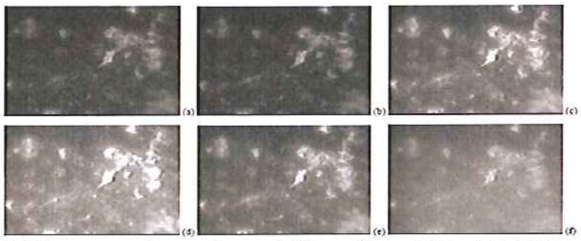

Fig 3: Fluorescence microscopy images of *chicken* residue on stainless steel, before application of washing step, as detected at various wavelengths from a monochromator; (a) 365 nm, (b) 395nm, (c) 435 nm, (d) 445 nm, (e) 470 nm, (f) 490 nm. The insignificant differences in visible areas with residue between 490 nm and the others are evident.

Summary Results

❑The wavelengths 365-445 nm were consistently able to illuminate both plant and animal based residue to different extents while 490nm showed the more surface structural features instead of residue (some results not shown).
❑There were deviations from this general trend as for instance, the level of detection of chicken residue was not significantly different on FRP irrespective of wavelength.
❑Detection of chicken residue on aluminium was better at 490 nm than at 365-395 nm.
❑The optimum wavelength for detection differed for various residues depending on the abiotic surfaces.
❑The cleaning step removed the residues significantly in most cases. However, where residuals were significant post-cleaning, the 365-395 nm wavelengths were significantly better for detecting animal residue on aluminium and stainless steel.
  ❑The 435-445 nm wavelengths were better for detecting plant residue on the FRP.