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Unusual *Enterobacteriaceae*: a *Salmonella cubana* that is Urease Positive

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This is the first report of a naturally occurring *Salmonella* that is urea positive. The strain was identified as *Salmonella cubana* and it was typical in all biochemical, serological, and bacteriophage reactions, except that it produced urease strongly.

Genetic interchanges among different species of *Enterobacteriaceae* have produced some unusual recombinants in otherwise typical species. These unusual strains have been isolated from clinical specimens and some striking examples include lactose (Lac)- and/or sucrose-positive *Salmonella* (2), H_2S^+ *Escherichia coli* (1) and Lac$^+$ *Proteus* (6). In this note we describe a naturally occurring strain of *Salmonella enteritidis* serotype Cubana which is urea positive on Christensen's urea agar (3) (designation: *S. cubana* urea +).

The strain was isolated from the urine of a 77-year-old male, and was submitted to the Center for Disease Control as number 3237-71. Except for urease production, the biochemical reactions were quite typical of those for *S. enteritidis*, whose composite reactions are included for comparison (3) in Table 1. Serological testing by the Tennessee Department of Public Health and Center for Disease Control indicated that the isolate was a typical serotype Cubana. In addition, the strain was lysed by the "*Salmonella* specific O1 phage" (4).

The population in the original tube was almost entirely urea$^+$; however, after 55 colonies were picked, a urea-negative (urea$^-$) clone was isolated. It also typed as serotype Cubana. After the original tube had been stored at room temperature for 30 months, the population was about 30% urea$^-$. Single colonies which were urea$^+$ also produced urea$^-$ clones after storage, and the latter typed as serotype Cubana. If a urea$^-$ clone had been isolated first, there would have been no question about the identification of this strain as a typical *Salmonella* (Table 1).

The definition of the tribe *Salmonelleae* includes the clause "urease is not produced"; however, a strain which is urea$^+$ should not be excluded from the tribe only on the basis of this

TABLE 1. *Biochemical reactions of the unusual strain compared to percentage reactions of Salmonella enteritidis*[a]

Test	Reaction given by:		
	S. cubana urea$^+$	*Salmonella enteritidis*	
Oxidase	−	−	0[b]
Nitrate to nitrite	+	+	100
Indole	−	−	1.2
Methyl red	+	+	100
Voges-Proskauer	−	−	0
Simmons' Citrate	+	V	89
H_2S on TSI	+	+	94
KCN	−	−	0.3
Motility	+	+	94
Gelatin	−	−	<1
Lysine	+	+	95
Arginine	+	V	65
Ornithine	+	+	97
Phenylalanine	−	−	0
Mucate	Weak	V	82
Malonate	−	−	0.6
Glucose acid	+	+	100
Glucose gas	+	+	96
Lactose	−	−	0.9
Sucrose	−	−	0.6
Mannitol	+	+	100
Dulcitol	+	+	96
Salicin	−	−	<1
Adonitol	−	−	0
Inositol	+	V	38
Sorbitol	+	+	94
Arabinose	+	+	99
Raffinose	−	−	3
Rhamnose	+	+	94
Urea (Christensen's)	+	−	0

[a] +, Positive reaction within 48 h. −, Negative reaction at 48 h. (V) Variable.

[b] Percent positive reactions in 1 to 2 days for *S. enteritidis* as given by Edwards and Ewing (3).

property if it is otherwise typical. Lewis and Rosen (Abstr. Annu. Meet. Amer. Soc. Microbiol. 1973, G218, p. 62) showed that *Proteus rettgeri* can transfer to *Salmonella typhi* and *S. typhimurium* a plasmid which codes for urease production. The origin of the strong urease in our isolate is not known. Its genetic material which codes for urease production may have originated in a *Proteus* and been transferred by conjugation or transduction. This would be similar to lactose-positive *Salmonella* which probably acquire lactose genes from *E. coli* in nature (2). Or, this may be a mutant which has lost the ability to regulate the amount of urease it produces, since most *Salmonella* we have tested hydrolyze urea, but extremely slowly (30 to 90 days).

The identification of *S. cubana* urea$^+$ would pose a problem for clinical laboratories which rely on the combination of triple sugar iron agar and urea agar to rule out *Proteus* because the strain is a strong urease producer (the urea slant becomes red in 1 to 3 h and the entire tube is red at 18 h). However, a more complete set of biochemical tests (phenylalanine, indole, KCN, and lysine decarboxylase or lysine iron agar would be particularly useful) would clearly rule out *Proteus* and make *Salmonella* suspect. Two other simple tests can be particularly helpful. Proteus species are very strong catalase producers but *Salmonella* are much weaker and slower (5). Place a drop of commercial 3% hydrogen peroxide on a suspect colony (usually Lac$^-$); instantaneous and vigorous bubbling would rule out *Salmonella* in almost all instances. Antibiograms are also useful in differentiating *Proteus* and *Salmonella*; *Proteus* is uniformly resistant to colistin but *Salmonella* is uniformly sensitive. Urea$^+$ *Salmonella* must be extremely rare in clinical specimens; however, we wonder if they have been overlooked in the past. Perhaps this report will stimulate others to isolate urea$^+$ *Salmonella* so that their incidence can be more accurately established.

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