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EXTENDED DURATION ORBITER MEDICAL PROJECT

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MICROBIAL AIR SAMPLER - STS-50/USML-1

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ABSTRACT

The Microbial Air Sampler was used on Mission Days 1, 7 and 13 in the Spacelab during STS-50/USML-1. Microbial air samples were collected using two types of media strips containing agar (Rose Bengal for yeast and molds, TSA for bacteria.) The bacterial level found on Day 1 was lower than experienced on previous Spacelab missions. A high level of fungi was present on Day 1, however subsequent samples on Day 7 and 13 did not indicate fungal growth. Bacterial growth was also minimized in this microgravity environment as the mission progressed. No pathogenic microorganisms were isolated, and the health risk from airborne microbes was minimal throughout the mission.

NOMENCLATURE

Aspergillus	Type of fungal growth
Bacillus	Type of bacterial growth
CFU/25 cm ²	Colony Forming Units in a 25 x 25 cm area - surface
CFU/m ³	Colony Forming Units in 1 cubic meter - air
Corynebacterium	Type of bacterial growth
EDOMP	Extended Duration Orbiter Medical Project
MAS	Microbial Air Sampler
Micrococcus	Type of bacterial growth
Orbiter	Flight deck and middeck area
Penicillium	Type of fungal growth
Rose Bengal	Agar material used to measure fungal growth
Staphylococcus	Type of bacterial growth
TSA	Trypicase Soy Agar for measuring bacterial growth. TSA has an inhibitor that keeps fungi from growing on this sample.

INTRODUCTION

Acceptable air quality must be maintained in the closed spacecraft environment to ensure that crew health and performance are not compromised (1). Microorganisms in the air can contribute to the degradation of air quality, and at increased levels can cause allergies and/or infections (2). The risk of increased airborne microbial load becomes greater with extended mission durations (1). Periodic sampling of the air to determine microbial levels provides an assessment of the air quality and the efficiency of the spacecraft air handling system (3).

The Microbial Air Sampler (MAS) is a commercially available, portable, hand-held instrument for estimating the number of microbial colony forming units in the air. The MAS facilitates periodic assessment of airborne microbial levels and provides necessary information on the effectiveness of air handling systems. This device is used in hospitals, pharmaceutical and cosmetic manufacturing operations, and in the food industry (4, 5).

Characterization of the airborne microbial load on previous Shuttle flights (STS-40 and STS-45) has not indicated a health risk to the crew (6, 7). With the mission duration increasing and number of crew living in a closed environment, the opportunity for microbial propagation increases (1). The data obtained previously has been insufficient to establish a baseline for microbial load which can be extrapolated to longer duration missions.

The levels and types of airborne bacteria and fungi are listed in the Table 3. For reference purposes, the pre and postflight surface sample results are included in Table 1 and the preflight air sample results in Table 2.

I. RESULTS

Day 1 samples exhibited a higher level (375 colony forming units per m³ of air) of fungi than has been observed previously, however no fungi were recovered from day 7 and 13 samples. The bacterial level found on day 1 was lower than experienced on previous Spacelab missions. The increased fungal growth may have inhibited the growth of bacteria.

II. DISCUSSION

The low relative humidity (30-50%) in the Spacelab tends to reduce fungal propagation. The fungi present during the day 1 sampling period probably resulted from growth in the Spacelab prior to being activated, as relative humidity levels may have been substantially higher. This hypothesis is further supported by the elimination of fungi during the subsequent sampling periods. The bacterial levels were 162 and 50 colony forming units per m³ on days 7 and 13, respectively. Unlike some previous missions, the bacterial levels did not increase as the mission progressed.

CONCLUSIONS

The data collected do not indicate an increase in airborne microbial load of the Spacelab during the mission, however the occupancy of this module by the crew is relatively low. Microbial levels in the Orbiter tend to be higher than those in the Spacelab, but no Orbiter samples were taken on this mission. It is recommended that both Orbiter and Spacelab samples be collected on future Spacelab missions for comparative analysis.

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6. STS-40 Microbiology Mission Report (Memorandum SD4/91-312)
7. STS-45 Microbiology Mission Report (Memorandum SD4/92-186)

Table 1. STS-50 Spacelab Surface Samples

SAMPLE SITE	L-32		L+0	
	MICROORGANISMS	QUANTITATION (CFU/25 cm ²)	MICROORGANISMS	QUANTITATION (CFU/25 cm ²)
Air Vent - Right Forward	No bacteria isolated	0	<i>Staphylococcus</i> species	3.7 x 10 ¹
	No fungi isolated	0	<i>Bacillus</i> species	0
Air Vent - Left Forward	<i>Staphylococcus</i> species	1.5 x 10 ¹	<i>Staphylococcus</i> species	7.5 x 10 ¹
	<i>Micrococcus</i> species		<i>Corynebacterium</i> species	0
Air Vent - Right Aft	No fungi isolated	0	No fungi isolated	
	No bacteria isolated	0	<i>Staphylococcus</i> species	3.0 x 10 ¹
Air Vent - Left Aft	No fungi isolated	0	<i>Micrococcus</i> species	
	No bacteria isolated	0	<i>Penicillium</i> species	9.9 x 10 ¹
			<i>Aspergillus</i> species	
	No fungi isolated	0	<i>Staphylococcus</i> species	<10
	No bacteria isolated	0	No fungi isolated	<5

Table 1. STS-50 Spacelab Surface Samples (continued)

SAMPLE SITE	L-32		L+0	
	MICROORGANISMS	QUANTITATION (CFU/25 cm ²)	MICROORGANISMS	QUANTITATION (CFU/25 cm ²)
Work Bench Rail	<i>Bacillus</i> species	7.5 x 10 ⁻¹	No bacteria isolated	0
	No fungi isolated	0	No fungi isolated	
Work Bench Utility Box	No bacteria isolated	0	<i>Staphylococcus</i> species	<10
	No fungi isolated	0	No fungi isolated	0

TABLE 2. QUANTITATION OF MICROORGANISMS ISOLATED FROM STS-50 ORBITER AIR

AREA	CFU/M ³ OF AIR			
	L-19		L-2	
	BACTERIA	FUNGI	BACTERIA	FUNGI
MIDDECK	162	0	0	0
FLIGHT DECK	275	0	75	0

Table 3. STS-50: Results of in-flight air sampling

SAMPLE AREA	DAY 1		
	TIME **	MICROORGANISM	QUANTITATION *
Spacelab Midmodule R5 - L5	9:45	<i>Staphylococcus</i> species	12
	9:52	<i>Penicillium</i> species	375
Bacteria Mean = 194 CFU/m ³			
DAY 7			
Spacelab R6 - R7	1:25	<i>Staphylococcus</i> species <i>Micrococcus</i> species	162
		No fungi isolated	0
Bacteria Mean = 81 CFU/m ³			
DAY 13			
Spacelab Midmodule R5 - L5	3:41	<i>Staphylococcus</i> species <i>Bacillus</i> species	50
	3:46	No fungi isolated	0
Bacteria Mean = 25 CFU/m ³			

*CFU / m³

** Mission - elapsed time

