
PAO

1
00:00:02,490 --> 00:00:04,670
>> Pat Ryan: The Modern
Science Laboratory is designed

2
00:00:04,670 --> 00:00:08,450
to spend almost two years
analyzing rock and soil samples

3
00:00:08,450 --> 00:00:12,730
to see if Mars is going to be
favorable for microbial life

4
00:00:12,730 --> 00:00:16,430
or to preserve any end to
preserve any clues they find

5
00:00:16,430 --> 00:00:18,950
about possible life that
was there in the past.

6
00:00:18,950 --> 00:00:23,190
The robotic missions that are
like this one are being worked

7
00:00:23,190 --> 00:00:25,700
from NASA centers
all over the country.

8
00:00:25,700 --> 00:00:29,740
They are stepping stones
to future missions to Mars.

9
00:00:29,740 --> 00:00:31,420
In fact, right here at
the Johnson Space Center,

10
00:00:31,420 --> 00:00:34,800
there are teams that are
working to develop the food

11
00:00:34,800 --> 00:00:38,570
that human crews would eat on
a mission that would take them

12
00:00:38,570 --> 00:00:40,710
to Mars and this morning
we're going to learn more

13
00:00:40,710 --> 00:00:43,600
about that effort from
Dr. Michele Perchonok

14
00:00:43,600 --> 00:00:46,880
who is the Advanced Food
Technology Project Scientist.

15
00:00:48,000 --> 00:00:47,520
Good morning.

16
00:00:48,000 --> 00:00:51,160
>> Pat: What how long has
NASA been working on issues

17
00:00:51,160 --> 00:00:53,490
about food for a
mission to Mars?

18
00:00:53,490 --> 00:00:55,930
>> Dr. Perchonok: Well I've
been at NASA for twelve years

19
00:00:55,930 --> 00:00:58,100
and they've been working on
it a lot longer than that

20
00:00:58,100 --> 00:01:00,650
so I'm going to say
about twenty years.

21

00:01:00,650 --> 00:01:03,260
>> Pat: I assume that we've
taken whatever we've learned

22
00:01:03,260 --> 00:01:06,210
feeding crews on previous
flights, on space station,

23
00:01:06,210 --> 00:01:09,260
on space shuttle and prior
missions is being rolled

24
00:01:09,260 --> 00:01:10,650
in here.

25
00:01:10,650 --> 00:01:14,730
What are the basics in trying
to develop something like this?

26
00:01:14,730 --> 00:01:16,970
>> Dr. Perchonok: Well we
have actually we call it a two

27
00:01:16,970 --> 00:01:20,700
pronged food system so first
is the packaged food system

28
00:01:20,700 --> 00:01:22,580
that we already have
and are using

29
00:01:22,580 --> 00:01:24,950
on International Space Station
but there's a little bit

30
00:01:24,950 --> 00:01:29,090
of a difference on International
Space Station our food only has

31
00:01:29,090 --> 00:01:30,940

to last about eighteen
months or so.

32
00:01:30,940 --> 00:01:31,900
>> Pat: Good.

33
00:01:31,900 --> 00:01:34,880
>> Dr. Perchonok: but on a
Mars mission they have to last

34
00:01:34,880 --> 00:01:38,040
about five years so that
takes into account the fact

35
00:01:38,040 --> 00:01:39,780
that they'll probably
preposition the food

36
00:01:39,780 --> 00:01:43,680
on orbit before the crew gets
there, the time it takes for us

37
00:01:43,680 --> 00:01:47,590
to make the food, as well as of
course the time that they have

38
00:01:47,590 --> 00:01:51,560
to eat it so five year shelf
life not seen anywhere else

39
00:01:51,560 --> 00:01:53,330
except maybe our military.

40
00:01:53,330 --> 00:01:55,440
The other piece of the
food system is once we're

41
00:01:55,440 --> 00:01:59,540
on the surface we can do what
we call a bioregenerative food

42
00:01:59,540 --> 00:02:03,050
system, that's growing in
garmental chambers fresh fruits

43
00:02:03,050 --> 00:02:06,480
and vegetables, either
growing or brining up in bulk,

44
00:02:06,480 --> 00:02:09,180
things like soy beans,
wheat berries, peanuts

45
00:02:09,180 --> 00:02:14,170
and then processing those
into ingredients such as tofu,

46
00:02:14,170 --> 00:02:17,900
or wheat flower into bread,
or into pasta and then

47
00:02:17,900 --> 00:02:22,290
of course the vegetables and
fruit can be used for just pick

48
00:02:22,290 --> 00:02:25,670
and eat, or to process
maybe into a tomato sauce,

49
00:02:25,670 --> 00:02:29,020
or into cooked vegetables
so the packaged food side

50
00:02:29,020 --> 00:02:31,700
of things yes we have some
experience but we have

51
00:02:31,700 --> 00:02:34,320
to go further but the
bioregenerative side we're

52
00:02:34,320 --> 00:02:36,210
really doing very
little of that right now.

53
00:02:36,210 --> 00:02:39,460
>> Pat: Are you thinking in
terms of growing it in the soil

54
00:02:39,460 --> 00:02:41,200
on Mars, growing food there?

55
00:02:41,200 --> 00:02:43,130
>> Dr. Perchonok:
No, so the thought is

56
00:02:43,130 --> 00:02:46,210
that we will instead be
using environmental chambers

57
00:02:46,210 --> 00:02:52,110
which will control the
temperature, the humidity,

58
00:02:52,110 --> 00:02:56,000
the lighting and then they
would be grown hydroponically

59
00:02:56,000 --> 00:02:59,290
so that we can recycle the
water and nutrients would be put

60
00:02:59,290 --> 00:03:04,290
into the water and also because
these chambers are limited

61
00:03:04,290 --> 00:03:08,200
in size we would probably
also be looking at dwarf

62
00:03:08,200 --> 00:03:11,200
like plants, so smaller version.

63
00:03:11,200 --> 00:03:11,980
>> Pat: tiny vegetables.

64
00:03:11,980 --> 00:03:13,530
>> Dr. Perchonok: Well,
cherry tomatoes instead

65
00:03:13,530 --> 00:03:14,720
of regular tomatoes,

66
00:03:14,720 --> 00:03:18,030
cherry tomato plants might
only grow one to two feet,

67
00:03:18,030 --> 00:03:21,800
whereas regular tomato plants
could grow four feet or so.

68
00:03:21,800 --> 00:03:24,400
>> Pat: In thinking about
this I was thinking in terms

69
00:03:24,400 --> 00:03:28,980
of feeding a crew on the way
to Mars and that sounds to me

70
00:03:28,980 --> 00:03:31,070
like there are certain
things you just have to do

71
00:03:31,070 --> 00:03:33,210
without because you
can't refrigerate

72
00:03:33,210 --> 00:03:35,210
and you can't carry that much.

73
00:03:35,210 --> 00:03:37,150
>> Dr. Perchonok: Right
so on the way to Mars,

74
00:03:37,150 --> 00:03:40,810
which is about a six month
trip, and on the way home,

75
00:03:40,810 --> 00:03:42,590
which is also a six month trip,

76
00:03:42,590 --> 00:03:44,590
providing that the
planets are aligned

77
00:03:44,590 --> 00:03:46,810
in their closest orientation,

78
00:03:46,810 --> 00:03:48,480
we would use a food
system very similar

79
00:03:48,480 --> 00:03:49,850
to International Space Station

80
00:03:49,850 --> 00:03:51,940
so it would be a
packaged food system

81
00:03:51,940 --> 00:03:54,020
where they're individually
packaged items

82
00:03:54,020 --> 00:03:59,000
for each crew member so it
would be a serving of meatloaf,

83
00:03:59,000 --> 00:04:01,470

or a serving of broccoli
au gratin

84
00:04:01,470 --> 00:04:05,860
and they would just basically
rehydrate or heat that food.

85
00:04:05,860 --> 00:04:10,360
>> Pat: Is there enough, how
much space does that much food

86
00:04:10,360 --> 00:04:13,500
for that size crew take up?

87
00:04:13,500 --> 00:04:15,750
>> Dr. Perchonok: It's
a lot so if you assume

88
00:04:15,750 --> 00:04:19,360
and we don't know the crew size
but if you assume a crew of six

89
00:04:19,360 --> 00:04:25,260
and you assume 1,000 day
mission, then we're talking

90
00:04:25,260 --> 00:04:29,230
about almost or about
twenty thousand pounds

91
00:04:29,230 --> 00:04:30,150
of packaged food.

92
00:04:30,150 --> 00:04:33,590
Now that doesn't assume any
of the bioregenerative part.

93
00:04:33,590 --> 00:04:39,190
Twenty thousand pounds of food,
the volume we calculated that

94
00:04:39,190 --> 00:04:41,620
and we think it's
about the amount

95
00:04:41,620 --> 00:04:45,080
of three large refrigerators
full so we're talking

96
00:04:45,080 --> 00:04:49,430
about a small room or a
large closet worth of food

97
00:04:49,430 --> 00:04:53,710
so doesn't sound like a lot
but that's really, really,

98
00:04:53,710 --> 00:04:55,250
really tightly packed.

99
00:04:55,250 --> 00:04:58,800
>> Pat: Apparently it would seem
to me that it would have to take

100
00:04:58,800 --> 00:05:00,420
up a lot more room than that.

101
00:05:00,420 --> 00:05:01,720
>> Dr. Perchonok: Gut feel yes

102
00:05:01,720 --> 00:05:04,930
and so you know we've
done the calculations

103
00:05:04,930 --> 00:05:08,330
and again its taking
into a lot of assumptions

104
00:05:08,330 --> 00:05:11,260

that we don't necessarily
know the real answer

105
00:05:11,260 --> 00:05:14,060
so how is it going
to be packaged?

106
00:05:14,060 --> 00:05:18,720
Are there going to be racks or
other sort of secondary places

107
00:05:18,720 --> 00:05:21,950
to stow them, in that case
it would take more room

108
00:05:21,950 --> 00:05:24,030
so that kind of information
we don't have

109
00:05:24,030 --> 00:05:28,030
yet so this is clearly just
the food, nothing else,

110
00:05:28,030 --> 00:05:30,370
so if you're going to pack it
into something and then pack it

111
00:05:30,370 --> 00:05:33,800
into something else, or
you have to add foam to it

112
00:05:33,800 --> 00:05:37,430
to protect the packaging,
that all is extra space.

113
00:05:37,430 --> 00:05:39,520
>> Pat: When you're
thinking about being able

114
00:05:39,520 --> 00:05:43,840

to provide a crew with all
the vitamins and minerals

115
00:05:43,840 --> 00:05:47,550
and nutrients that they need,
do you assume that it all comes

116
00:05:47,550 --> 00:05:51,790
from meals that they eat or
are there other supplements

117
00:05:51,790 --> 00:05:53,280
that help you do that?

118
00:05:53,280 --> 00:05:54,840
>> Dr. Perchonok:
So currently on ISS,

119
00:05:54,840 --> 00:05:57,110
International Space
Station, the only supplement

120
00:05:57,110 --> 00:05:59,720
that the crew is required
to take is vitamin D

121
00:05:59,720 --> 00:06:03,600
because the only way to really
get vitamin D in any quantity is

122
00:06:03,600 --> 00:06:07,820
from the sun and obviously
they're not having any sunshine.

123
00:06:07,820 --> 00:06:11,670
There are ways in the food
to do it but not as easily.

124
00:06:11,670 --> 00:06:14,040
We have to make the

assumption to try

125
00:06:14,040 --> 00:06:17,700
to give them all the nutrients
they need, all of the vitamins

126
00:06:17,700 --> 00:06:21,960
and minerals and protein,
carbohydrate, fat, calories etc.

127
00:06:21,960 --> 00:06:25,550
through the food because
ironically, or much more

128
00:06:25,550 --> 00:06:28,320
of a challenge, is
that nutrients

129
00:06:28,320 --> 00:06:32,650
in a pill actually break down
faster than the nutrients

130
00:06:32,650 --> 00:06:35,600
in the food so chemistry
happens whether it's

131
00:06:35,600 --> 00:06:37,830
in a pill form or the food form.

132
00:06:37,830 --> 00:06:39,360
It seems like that matrix

133
00:06:39,360 --> 00:06:42,320
in the food is actually
protecting the vitamins

134
00:06:42,320 --> 00:06:45,830
so if we can bring up enough
food with enough quantity

135
00:06:45,830 --> 00:06:49,080
of vitamins and minerals
in that food we're ok.

136
00:06:49,080 --> 00:06:52,280
The problem is in the
packaged food system

137
00:06:52,280 --> 00:06:54,640
to make sure its stable
without a refrigerator

138
00:06:54,640 --> 00:06:56,430
or freezer we have to process it

139
00:06:56,430 --> 00:07:00,590
and that process often
will be partly heat

140
00:07:00,590 --> 00:07:04,060
to kill the micro-organisms,
or radiation to kill them,

141
00:07:04,060 --> 00:07:08,450
or drying it down to allow

142
00:07:08,450 --> 00:07:11,590
so that the micro-organisms
can't grow.

143
00:07:11,590 --> 00:07:13,810
Now we have new technologies
we're looking

144
00:07:13,810 --> 00:07:16,230
at microwave sterilization,
high pressure,

145
00:07:16,230 --> 00:07:18,690

which look at killing the
micro-organisms either

146
00:07:18,690 --> 00:07:22,030
by through the pressure of
breaking the cell structure

147
00:07:22,030 --> 00:07:25,670
or microwaves but either
way we're introducing a step

148
00:07:25,670 --> 00:07:28,830
that can kill not only the
micro-organisms but some

149
00:07:28,830 --> 00:07:31,070
of the nutrients so we have
that challenge in there.

150
00:07:31,070 --> 00:07:34,160
>> Pat: And that's part of what
we do in the station food now

151
00:07:34,160 --> 00:07:36,870
with the freeze dried food
and thermostabalized food.

152
00:07:36,870 --> 00:07:37,250
>> Dr. Perchonok:
Correct, correct.

153
00:07:37,250 --> 00:07:39,960
All of that is already
on station and one

154
00:07:39,960 --> 00:07:43,600
of our studies is looking
at not only how much

155
00:07:43,600 --> 00:07:46,490

of the nutrients you lose
through the processing but then

156
00:07:46,490 --> 00:07:50,930
if you look at them at ambient
or room temperature storage

157
00:07:50,930 --> 00:07:53,920
for one year or three years
how much more are you losing

158
00:07:53,920 --> 00:07:57,460
because unfortunately that
chemistry continues to happen

159
00:07:57,460 --> 00:07:58,970
and we lose more nutrients.

160
00:07:58,970 --> 00:08:01,360
>> Pat: Does that mean you
have to add more nutrients

161
00:08:01,360 --> 00:08:04,150
to them ahead of time to
account for the degradation?

162
00:08:04,150 --> 00:08:07,200
>> Dr. Perchonok: So that's one
way to do it and we would call

163
00:08:07,200 --> 00:08:09,930
that fortification and
actually in our beverages

164
00:08:09,930 --> 00:08:14,060
that are fortified because
the beverages were dried

165
00:08:14,060 --> 00:08:17,360
and then you add

the vitamins to it,

166
00:08:17,360 --> 00:08:21,130
they actually do maintain
more vitamin stability.

167
00:08:21,130 --> 00:08:23,370
The other way now is to
protect those vitamins:

168
00:08:23,370 --> 00:08:24,720
Can you encapsulate them?

169
00:08:24,720 --> 00:08:26,440
Can you do something
else to them

170
00:08:26,440 --> 00:08:30,410
so that they are more protected
and think of it as almost

171
00:08:30,410 --> 00:08:35,290
like in a shell so that they
don't react with the water

172
00:08:35,290 --> 00:08:38,890
or the oxygen out there and
allow them to stay more stable

173
00:08:38,890 --> 00:08:40,730
for longer periods of time.

174
00:08:40,730 --> 00:08:43,460
>> Pat: It's very
interesting to think about that

175
00:08:43,460 --> 00:08:45,220
down to the details
but we sucked all

176
00:08:45,220 --> 00:08:47,950
of the excitement
out of food too.

177
00:08:47,950 --> 00:08:48,970
[laughter] Are the
crew members going

178
00:08:48,970 --> 00:08:53,770
to get bored having what I
guess is a narrow selection

179
00:08:53,770 --> 00:08:55,540
over the course of
two or three years?

180
00:08:55,540 --> 00:08:58,100
>> Dr. Perchonok: So that is
another study we're doing is

181
00:08:58,100 --> 00:09:01,150
looking at how much
variety do you need?

182
00:09:01,150 --> 00:09:03,930
How can you sort of
mix it up a little bit

183
00:09:03,930 --> 00:09:05,570
with different condiments?

184
00:09:05,570 --> 00:09:06,790
How do you make it more special

185
00:09:06,790 --> 00:09:10,090
with extra you know special
meals whether its holidays

186
00:09:10,090 --> 00:09:13,980

or birthdays or just say it's
the first Sunday of the month

187
00:09:13,980 --> 00:09:18,400
but right now we have
about 180 food items

188
00:09:18,400 --> 00:09:22,150
on International Space Station
and that seems to be well

189
00:09:22,150 --> 00:09:25,910
and then we have another
hundred or so items from Russia

190
00:09:25,910 --> 00:09:28,500
and some more from
Europe so we're probably

191
00:09:28,500 --> 00:09:31,800
at about a three hundred
number and that seems

192
00:09:31,800 --> 00:09:36,450
to be the right number
for a six month mission.

193
00:09:36,450 --> 00:09:40,200
What do you need for a two and a
half year mission and that's one

194
00:09:40,200 --> 00:09:41,330
of the reasons why we're looking

195
00:09:41,330 --> 00:09:43,010
at this bioregenerative
food system

196
00:09:43,010 --> 00:09:45,560
because it introduces a

little bit more variety,

197
00:09:45,560 --> 00:09:48,000
it introduces a little
bit more creativity,

198
00:09:48,000 --> 00:09:49,930
well you know tonight
I'm going to put

199
00:09:49,930 --> 00:09:52,580
in my pasta sauce bell
peppers but not onions

200
00:09:52,580 --> 00:09:54,970
and the next night I'm
going to put in onions

201
00:09:54,970 --> 00:09:57,720
and not bell peppers so
it's a little bit different

202
00:09:57,720 --> 00:10:00,320
but yes they are going to
get bored, it's not like here

203
00:10:00,320 --> 00:10:03,920
on earth where we can say I
don't feel like eating anything

204
00:10:03,920 --> 00:10:05,540
out of my refrigerator
so I'm going to go

205
00:10:05,540 --> 00:10:08,270
to a restaurant tonight.

206
00:10:08,270 --> 00:10:10,940
>> Pat: If you get bored with
the food as a crew member might

207
00:10:10,940 --> 00:10:14,450
in this circumstance do you
find that they don't eat as much

208
00:10:14,450 --> 00:10:15,380
as they're supposed to?

209
00:10:15,380 --> 00:10:16,680
>> Dr. Perchonok: That
is what we're finding

210
00:10:16,680 --> 00:10:19,160
that they don't eat as much when
they're bored with the food,

211
00:10:19,160 --> 00:10:22,360
that the acceptability of
the food goes down and so

212
00:10:22,360 --> 00:10:26,350
and that's a big concern
because this food allows them

213
00:10:26,350 --> 00:10:31,100
to perform well, keep healthy
and more importantly it helps

214
00:10:31,100 --> 00:10:34,390
to mitigate the bone
loss and muscle mass loss

215
00:10:34,390 --> 00:10:38,800
that they do experience
in microgravity.

216
00:10:38,800 --> 00:10:41,270
>> Pat: What kinds of things
do you have on the menu

217
00:10:41,270 --> 00:10:42,730
at this point, if
we were launching

218
00:10:42,730 --> 00:10:44,020
to Mars tomorrow what kind

219
00:10:44,020 --> 00:10:46,620
of food would be
available for a crew?

220
00:10:46,620 --> 00:10:47,550
>> Dr. Perchonok: Well right now

221
00:10:47,550 --> 00:10:50,060
of our sixty plus
thermostabalized items,

222
00:10:50,060 --> 00:10:51,990
which is basically
canned food in a pouch,

223
00:10:51,990 --> 00:10:55,150
only seven of them have
a five year shelf life

224
00:10:55,150 --> 00:11:01,190
and they all happen to be meat
items so brisket, pork chops,

225
00:11:01,190 --> 00:11:04,170
meatloaf, so not
a lot of variety

226
00:11:04,170 --> 00:11:08,590
but we're working towards
trying to get that improved

227
00:11:08,590 --> 00:11:12,650

and making sure that they have
a good variety of items just

228
00:11:12,650 --> 00:11:14,570
like they do on International
Space Station

229
00:11:14,570 --> 00:11:17,400
from chocolate pudding
cake for dessert,

230
00:11:17,400 --> 00:11:23,170
to having scrambled eggs or a
cinnamon scone for breakfast

231
00:11:23,170 --> 00:11:26,820
and you know fruit you know
strawberries or whatever

232
00:11:26,820 --> 00:11:28,870
so we're working towards it.

233
00:11:28,870 --> 00:11:31,810
>> Pat: Now in this case
you got maybe twenty years

234
00:11:31,810 --> 00:11:34,810
or more before we're
ready to make that trip is

235
00:11:34,810 --> 00:11:38,330
that why we need to be preparing
the menu now for a trip

236
00:11:38,330 --> 00:11:40,640
that doesn't launch until
the twenty thirties?

237
00:11:40,640 --> 00:11:43,530
>> Dr. Perchonok: Well you're

right, we have a lot of time,

238
00:11:43,530 --> 00:11:47,070
however, the bioregenerative
food system piece we're

239
00:11:47,070 --> 00:11:50,420
estimating could take ten if
not fifteen years to develop

240
00:11:50,420 --> 00:11:54,180
because not only do we have to
determine what we want to do

241
00:11:54,180 --> 00:11:56,900
with it, what we want to grow
but then what do you need

242
00:11:56,900 --> 00:11:58,910
to process and what
equipment do you need for that

243
00:11:58,910 --> 00:12:02,800
and you'll have a galley
that I describe as a sort

244
00:12:02,800 --> 00:12:05,080
of a twenty first century galley

245
00:12:05,080 --> 00:12:07,550
but a fifteenth century
operations

246
00:12:07,550 --> 00:12:15,740
because you may have a juicer or
a food processor but meanwhile

247
00:12:15,740 --> 00:12:19,000
if you're making bread you're
either going to have to knead it

248
00:12:19,000 --> 00:12:21,110
by hand or have a bread maker,

249
00:12:21,110 --> 00:12:23,350
or if you want grated
carrots you're going to have

250
00:12:23,350 --> 00:12:25,720
to grate them, you can't go
to the grocery store and pick

251
00:12:25,720 --> 00:12:29,570
up those grated carrots
so there's a lot involved

252
00:12:29,570 --> 00:12:31,990
in the bioregenerative
food system.

253
00:12:31,990 --> 00:12:35,140
So what we're trying to do
is say ok we're going to sort

254
00:12:35,140 --> 00:12:37,060
of put that out in the future

255
00:12:37,060 --> 00:12:40,150
and not necessarily do it right
away but right now let's look

256
00:12:40,150 --> 00:12:41,800
at that packaged food system

257
00:12:41,800 --> 00:12:45,200
because if we can extend the
shelf life now that makes

258
00:12:45,200 --> 00:12:46,850

that if you think about it

259
00:12:46,850 --> 00:12:50,440
if you can have a higher
quality food up front

260
00:12:50,440 --> 00:12:52,580
so that it doesn't it's
still good in five years,

261
00:12:52,580 --> 00:12:55,170
think about how good it would
be in one year or two years

262
00:12:55,170 --> 00:12:59,030
for International Space Station
so we're working on that first.

263
00:12:59,030 --> 00:13:04,260
We hope to have a five year
shelf life food system ready.

264
00:13:04,260 --> 00:13:07,110
Knowing how to do it, not
necessarily having developed all

265
00:13:07,110 --> 00:13:10,950
of those two hundred plus
products by about twenty twenty

266
00:13:10,950 --> 00:13:13,800
and then we can take
some time to develop all

267
00:13:13,800 --> 00:13:16,550
of those formulations, we
don't call them recipes,

268
00:13:16,550 --> 00:13:17,680
we call them formulations.

269
00:13:17,680 --> 00:13:21,580
>> Pat: It all sounds very
interesting and be interesting

270
00:13:21,580 --> 00:13:23,710
to see how it turns
out, what comes up next.

271
00:13:23,710 --> 00:13:26,350
Thanks for your for bringing
us up to date on that.

272
00:13:26,350 --> 00:13:26,970
>> Dr. Perchonok:
You're welcome.