



**UNIVERSITY OF PAPUA NEW GUINEA
SCHOOL OF MEDICINE AND HEALTH SCIENCES
DIVISION OF BASIC MEDICAL SCIENCES**

P.O. BOX 5623, BOROKO, NCD
PAPUA NEW GUINEA

TEL: (675+) 3243811; 3112626
FAX: (675+) 3250809

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ASSESSMENT OF FORTIFICATION OF RICE AND SALT SOLD IN SOME CITIES IN PNG

INTRODUCTION:

Micronutrient deficiency, also called “Hidden Hunger” is a major obstacle to sustainable development in a community. The impact of “Hidden Hunger” is multifaceted: It increases the risk factors for disease burden, economic and social deprivation, because of its long ranging negative effects on the health of affected individuals and the community as a whole [1 – 5].

Iron deficiency and Iodine deficiency are two major examples of Hidden Hunger, resulting from micronutrient deficiency. Elimination or significant reduction of Hidden Hunger among women and children is a public health priority for many countries, regardless of their economic development. Many countries, including PNG, have taken steps to reduce Hidden Hunger through different intervention strategies. In PNG, Iron fortification of white rice and salt iodization are two strategies that have been implemented to reduce hidden hunger. Legislation for mandatory fortification of white rice was introduced in PNG in 2007 [6]. The PNG Salt Legislation for fortification of all salt samples with Iodine was introduced in 1995 [6, 7].

Anaemia is one of the global public health problems in resource limited countries like PNG with major negative impact on human health and on social and economic development [3, 4, 8]. Anaemia is the world’s second leading cause of disability among children, non-pregnant, pregnant and lactating women. According to the WHO about 50% of all cases of anaemia are related to Iron deficiency [3]. Iron fortification of staple foods is one of the recommended long-term cost-effective strategies for control and prevention of Iron deficiency among at-risk groups in the population [9 – 11].

Iodine is required for biosynthesis of Thyroid Hormones: Thyroxine (T4) and Triiodothyronine (T3). Low dietary intake and utilization of Iodine can cause the spectrum of diseases, called “Iodine Deficiency Disorders (IDD)”. Iodine deficiency is the world’s greatest single cause of preventable mental retardation [12 – 15]. Mild to moderate iodine deficiency in “apparently” healthy children can cause stunted growth, impaired learning ability, underperformance in school, poor performance in

psychometric tests, impaired physical and cognitive function, and reduced capacity for critical thinking. In adults, low intake of iodine can cause, hypothyroidism, which may be characterized by low work capacity, reduced productivity, dry scaly skin, tingling and numbness in extremities, forgetfulness, depression, personality changes, anemia, and high blood cholesterol. It can also affect public health policies and strategies for prevention and control of malaria, TB, HIV/AIDS and other diseases [12 – 15]. Universal Salt Iodization (USI) is the most effective and sustainable intervention strategy for prevention, control, and elimination of iodine deficiency in a population. USI strategy was implemented in PNG in June 1995 with enactment of PNG Salt Legislation that prohibits importation, production and sale of non-iodised salt. The PNG Food Sanitation Regulation states that iodine content in salt used in PNG should not be less than 30.0ppm (30mg of iodine per kilogram of salt).

The Issue in PNG:

Current situation with Iron fortification of white rice in PNG and salt fortification with Iodine raises some major questions:

Are the different brands of white rice sold in PNG fortified with Iron?

Rice can be fortified either by Kernels or Dusting technologies; what type of technology is used for the fortification of white rice with iron in PNG?

Are the different brands of salt sold in PNG adequately fortified according to PNG standard?

The nutritional objectives in the PNG National Health Plan [16] and Vision 2050 [17], include the following: Reduction of Anaemia among women and children in the population; elimination of IDD and to monitor the availability and utilization of adequately iodized salt at district and provincial levels.

In order to ensure an effective and sustainable food fortification program, the government needs to ensure that only fortified foods (salt and rice) that meet national standards are imported and are sold in the country.

Thus the major objective of this project was to assess the extent of compliance with national fortification standards. The data collected included the number of brands of rice and salt sold in selected cities, so as to determine the number of brands that are fortified according to the national standards.

Qualitative test was carried out to assess the presence and type of Iron fortificant in rice and the WYD test was used to quantitatively assess the Iodine content in salt. All the data obtained were analysed statistically. It is hoped that the results will be used to advocate for effective monitoring of fortified rice and salt sold in the country.

This project is in line with the nutrition policy in the PNG National Health Plan and Vision 2050 [16, 17]: Consumption of adequate and safe nutritious meals is the best form of preventive medicine and a guarantee of good health for the community. It is needed to improve the health and lives of all Papua New Guineans, and to become “Smart, Wise, Fair, Healthy and Happy Society”.

METHODOLOGY:

Rice and Salt samples:

Two batches of rice and salt samples were delivered to the Micronutrient Research Laboratory (MRL) in the Division of Basic Medical Sciences (BMS) School of Medicine and Health Sciences (SMHS) University of Papua New Guinea (UPNG) for analysis. The samples were delivered by senior Environmental Health Officials (EHO) in NDoH.

In the MRL, the information on the documents in the boxes and the label on each of the samples were checked and recorded. The number of samples, including the identification number (ID#) on the label on each of the zip-locked polythene bags with rice and salt samples, was also recorded.

Based on the recorded information, the rice and salt samples in the first batch were from five cities (Hela, Goroka, Alotau, Lae and Madang). The second batch contained rice and salt samples from seven cities (Port Moresby, Madang, Vanimo, Kimbe, Biella, Rabaul and Keravat). Thus the two batches combined contained rice and salt samples from 11 cities (because samples from Madang was in both batches) in PNG.

The list showing the codes for the cities, companies, locations, brands of rice and salt and also the codes for the rice and salt samples are presented in **Annex 1**.

Detection of Iron in white rice:

Two different techniques are used for the fortification of white rice with Iron. They are fortification with Kernels and fortification by Dusting [9].

The Standard Operating Procedure (SOP) which is a qualitative spot test to detect the presence of Iron in fortified white rice was made available for this project by courtesy of colleagues in Food Fortification Initiative (FFI) [18]. Hydrochloric Acid and Potassium Thiocyanate were used to prepare the solution for the SOP used in this study. The SOP was used to detect Iron in rice fortified by kernel and dusting.

Procedure: The rice in the zip-locked bag was mixed properly and then, about 50 grams of the rice was spread in a small size plastic plate. The SOP solution was poured into a clean plastic spray bottle. Then 8 to 10 puffs were sprayed onto the 50g rice on the plastic plate to wet the rice. The rice on the plate was examined visually after 2 to 3 minutes. The appearance of dark red kernels or dust in the rice indicates the presence of Iron.

Annex 2 shows the expected results of rice with no iron, rice fortified by kernels, rice fortified by dusting and rice fortified by both kernel and dusting (mixed).

Quantitative assay of Iodine content in Salt:

The assay of iodine in salt sample was carried out using the WYD Iodine Checker, which is specifically used to determine the amount of iodine in iodized salt sample. The amount of iodine is expressed in parts per million (ppm) which is equivalent to one mg of iodine per kilogram of salt (mg/kg) {mg/kg =

ppm}. The WYD Iodine checker measures the amount of iodine in salt iodized with either Potassium Iodate or Potassium Iodide [19].

Criteria for Interpretation of the results on Iodine content in salt (salt iodization):

The criteria for interpretation of the salt iodine results are based on the PNG salt legislation [6, 7]. According to the legislation all salt must be iodised with potassium Iodate; the amount of iodine in table salt should be 40.0 to 70.0mg/kg (ppm); the amount of iodine in other salt should be 30.0 to 50.0mg/kg. These levels of iodine should be present at production or at the point of import.

WHO recommendations for iodine levels of food grade salt aim to provide 150µg iodine per day, assume 92% bioavailability, 30% losses from production to household level before consumption [12]. If 30% of iodine is lost from salt iodised as per PNG salt legislation, iodine content of table salt at household level should be between 28.0mg/kg (40mg/kg minus 30%) and 49.0mg/kg (70mg/kg minus 30%). This implies that in PNG the iodine content in salt in retail outlets or at the time of consumption should be between 28.0mg/kg and 49.0mg/kg. Some recent publications on salt iodisation in PNG have rounded up the cut-off points by using “**30.0 to 50.0mg/kg**”. In this report, for the purpose of comparison the rounded up cut-off points (30.0 to 50.0mg/kg) have been used for presentation of the results. Salt with iodine levels of less than 5.0mg per kg is considered non-iodised salt [20].

Some of the recommended guidelines used to format the tables in which the results are presented included the following:

- *Strata are illustrative and should be modified and adapted as required and as programmatically relevant.*
- *While it is recommended that the definition of “no iodine” is maintained in different settings, definitions of “Inadequate”, “Adequate” and “Excess” Iodine should be modified based on national standards, (the cut-off points in the PNG Salt Legislation [6, 7] is used in the present results).*

RESULTS AND COMMENTS:

(The results will be presented in two parts: Results for rice fortification and Results for salt fortification).

FORTIFICATION OF RICE WITH IRON:

A total of 45 rice samples were in batch 1 and 104 rice samples in batch 2. The two batches were combined for data analysis. Thus, data analysis was carried out for the 149 rice samples from 11 cities. The data is presented in the Excel Spreadsheets: “Atch 1 results Iron in Rice NDOH 2019”.

The 149 white rice samples were received and analysed for presence of iron using the Standard Operating Procedure (SOP) for qualitative assessment of Iron in rice. The 149 rice samples were sorted using the brand codes and names provided by the EHO NDOH. There were 21 different brands of rice.

The number and frequency distribution of the 149 rice samples according to their brands are presented in Table 1. Brands A12 and C4 had the highest frequency of 8.7% (13/149), followed by brands A11

and C3 with frequency of 7.4% (11/149) and brands A10, B7, B13 and C1 with frequency of 6.7% (10/149). The frequencies of the other brands are shown in Table 1.

BRAND CODES	BRAND NAMES	NUMBER (N = 149)	FREQUENCY (%)
A 9	Skel long grain	8	5.4
A 10	Skel Jasmine	10	6.7
A 11	Skel Ori rice	11	7.4
A 12	Skel rice medium grain	13	8.7
A 14	Sweet and Soft	9	6.0
B 5	Super A One	7	4.7
B 6	Frangipani	9	6.0
B 7	Thai Jasmine	10	6.7
B 8	Thai Hom Mali Jasmine	7	4.7
B 13	Star rice	10	6.7
B 16	Sweet rice	3	2.0
C 1	Trukai medium	10	6.7
C 2	Trukai Jasmine	8	5.4
C 3	Trukai roots	11	7.4
C 4	Trukai roots long grain	13	8.7
C 15	King rice	2	1.3
D 17	Tru rice	2	1.3
D 18	Tru Jasmine	2	1.3
D 19	Tru Value	2	1.3
E 20	Jasmine	1	0.7
T 99	Root	1	0.7
TOTAL		149	100

All the 149 rice samples were sorted according to the method used for iron fortification. The result obtained is presented in Table 2. Rice samples fortified with appropriate amount of “dusting fortificant” are indicated as “Dusting”, those with low amount of “dusting fortificant” are indicated as “Light Dusting”. Those fortified with appropriate amount of Kernels are indicated as “Kernel”. Those with low amount of kernels are indicated as “Kernel (poor)”. “Negative” indicates that Iron was not detected in the rice at the time of testing.

Table 3 shows the distribution of the 149 rice samples according to the type of fortification method used. The results are also illustrated in Fig.1. Dusting method was used for fortification of 16.8% (25/149) of the rice samples and Kernel method was used for fortification in 67.1% (100/149) of the rice samples. Both kernel and dusting (Mixed) was used for fortification of 8.7% (13/149) of the rice samples. At the time of testing No iron fortificant (Negative) was detected in 7.4% (11/149) of the rice samples. The photos of the results for each of the rice samples are presented in the two folders attached (“Photos for batch I” and “photos for batch II”). The photos clearly show the presence or

absent of Iron in the white rice sample tested. Note that some of the photos are in duplicate or triplicate for clarity.

#	Rice	Name of Cities	Identification Codes	Brand names	Fortification method used
1	RA 03	Port Moresby	BSB 6	Frangipani	DUSTING
2	RA 07	VANIMO	BSB 6	Frangipani	DUSTING
3	RA 091	ANDERSON	BSB 6	Frangipani	DUSTING
4	RA 093	KERAVAT	BSB 6 (B)	Frangipani	DUSTING
5	RA 094	SOHO	BSB 6	Frangipani	DUSTING
6	RA 07	VANIMO	ASA 11	Skel Ori rice	DUSTING
7	RA 02	GOROKA	BSB 13_2406	Star rice	DUSTING
8	RA 05	LAE	BSB 13_2107	Star rice	DUSTING
9	RA 06	MADANG	BSB 13	Star rice	DUSTING
10	RA 07	VANIMO	BSB 13	Star rice	DUSTING
11	RA 091	ANDERSON	BSB 13	Star rice	DUSTING
12	RA 092	TROPICANA	BSB 13	Star rice	DUSTING
13	RA 093	KERAVAT	BSB 13	Star rice	DUSTING
14	RA 02	GOROKA	BSB 5_2406	Super A One	DUSTING
15	RA 06	MADANG	BSB 5_2407	Super A One	DUSTING
16	RA 093	KERAVAT	BSB 5 (B)	Super A One	DUSTING
17	RA 094	SOHO	BSB 5	Super A One	DUSTING
18	RA 04	ALOTAU	BSB 16_1307	Sweet rice	DUSTING
19	RA 081	BIALLA	BSB 8	Thai Hom Mali jasmine	DUSTING
20	RA 094	SOHO	BSB 8	Thai Hom Mali jasmine	DUSTING
21	RA 081	BIALLA	BSB 7	Thai jasmine	DUSTING
22	RA 091	ANDERSON	BSB 7	Thai jasmine	DUSTING
23	RA 093	KERAVAT	BSB 7 (A)	Thai jasmine	DUSTING (Light)
24	RA 093	KERAVAT	BSB 7 (B)	Thai jasmine	DUSTING (Light)
25	RA 094	SOHO	BSB 7	Thai jasmine	DUSTING (Light)
26	RA 02	GOROKA	BSB 6_2406	Frangipani	KERNEL
27	RA 03	Port Moresby	ESE 20	Jasmin rice	KERNEL
28	RA 05	LAE	CSC 15_2107	King rice	KERNEL
29	RA 03	Port Moresby	CSC 15	King rice	KERNEL
30	RA 06	MADANG	T 99_2407	Root rice	KERNEL
31	RA 03	Port Moresby	ASA 10	Skel jasmine	KERNEL
32	RA 04	ALOTAU	ATA 10_1307	Skel Jasmine	KERNEL
33	RA 05	LAE	ASA 10_2107	Skel Jasmine	KERNEL

34	RA 06	MADANG	ASA 10	Skel jasmine	KERNEL
35	RA 08	KIMBE	ASA 10	Skel jasmine	KERNEL
36	RA 092	TROPICANA	ASA 10	Skel jasmine	KERNEL
37	RA 093	KERAVAT	ASA 10	Skel jasmine	KERNEL
38	RA 094	SOHO	ASA 10	Skel jasmine	KERNEL
39	RA 095	NH TRADING	ASA 10	Skel jasmine	KERNEL
40	RA 02	GOROKA	ASA 9_2406	Skel long grain	KERNEL
41	RA 03	Port Moresby	ASA 9	Skel long grain	KERNEL
42	RA 06	MADANG	ASA 9	Skel long grain	KERNEL
43	RA 081	BIALLA	ASA 9	Skel long grain	KERNEL
44	RA 091	ANDERSON	ASA 9	Skel long grain	KERNEL
45	RA 092	TROPICANA	ASA 9	Skel long grain	KERNEL
46	RA 093	KERAVAT	ASA 9	Skel long grain	KERNEL
47	RA 095	NH TRADING	ASA 9	Skel long grain	KERNEL
48	RA 02	GOROKA	ASA 11_2406	Skel Ori rice	KERNEL
49	RA 03	Port Moresby	ASA 11	Skel Ori rice	KERNEL
50	RA 04	ALOTAU	ASA 11_1307	Skel Ori rice	KERNEL
51	RA 05	LAE	ASA 11_2107	Skel Ori rice	KERNEL
52	RA 06	MADANG	ASA 11_2407	Skel Ori rice	KERNEL
53	RA 08	KIMBE	ASA 11	Skel Ori rice	KERNEL
54	RA 081	BIALLA	ASA 11	Skel Ori rice	KERNEL
55	RA 094	SOHO	ASA 11	Skel Ori rice	KERNEL
56	RA 095	NH TRADING	ASA 11	Skel Ori rice	KERNEL
57	RA 01	HELA	ATA 12_1406	Skel rice medium grain	KERNEL
58	RA 02	GOROKA	ASA 12_2406	Skel rice medium grain	KERNEL
59	RA 04	ALOTAU	ATA 12_1307	Skel rice medium grain	KERNEL
60	RA 05	LAE	ASA 12_2107	Skel rice medium grain	KERNEL
61	RA 06	MADANG	ASA 12	Skel rice medium grain	KERNEL
62	RA 07	VANIMO	ASA 12	Skel rice medium grain	KERNEL
63	RA 08	KIMBE	ASA 12	Skel rice medium grain	KERNEL
64	RA 081	BIALLA	ASA 12	Skel rice medium grain	KERNEL
65	RA 091	ANDERSON	ASA 12	Skel rice medium grain	KERNEL
66	RA 093	KERAVAT	ASA 12	Skel rice medium grain	KERNEL
67	RA 094	SOHO	ASA 12	Skel rice medium grain	KERNEL
68	RA 095	NH TRADING	ASA 12	Skel rice medium grain	KERNEL
69	RA 03	Port Moresby	BSB 13	Star rice	KERNEL
70	RA 03	Port Moresby	ASA 14	Sweet and Soft	KERNEL
71	RA 04	ALOTAU	ATA 14_1307	Sweet and Soft	KERNEL
72	RA 05	LAE	ASA 14_2107	Sweet and Soft	KERNEL
73	RA 06	MADANG	ASA 14_2407	Sweet and Soft	KERNEL
74	RA 08	KIMBE	ASA 14	Sweet and Soft	KERNEL
75	RA 091	ANDERSON	ASA 14	Sweet and Soft	KERNEL

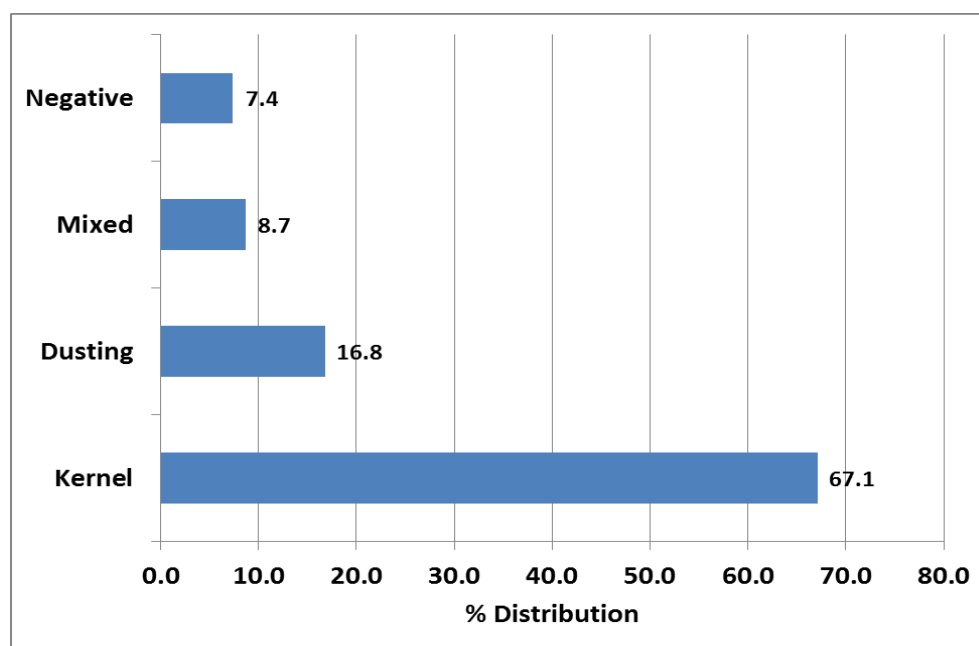
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77	RA 094	SOHO	ASA 14	Sweet and Soft	KERNEL
78	RA 08	KIMBE	DSD 18	Tru Jasmine	KERNEL
79	RA 03	Port Moresby	DSD 17	Tru rice	KERNEL
80	RA 08	KIMBE	DSD 17	Tru rice	KERNEL
81	RA 03	Port Moresby	DSD 19	Tru value	KERNEL
82	RA 08	KIMBE	DSD 19	Tru value	KERNEL
83	RA 02	GOROKA	CWC 2_2406	Trukai Jasmine	KERNEL
84	RA 03	Port Moresby	CSC 2	Trukai jasmine	KERNEL
85	RA 04	ALOTAU	CSC 2_1307	Trukai Jasmine	KERNEL
86	RA 06	MADANG	CSC 2_2407	Trukai Jasmine	KERNEL
87	RA 08	KIMBE	CSC 2	Trukai jasmine	KERNEL
88	RA 081	BIALLA	CSC 2	Trukai jasmine	KERNEL
89	RA 092	TROPICANA	CSC 2	Trukai jasmine	KERNEL
90	RA 094	SOHO	CSC 2	Trukai jasmine	KERNEL
91	RA 02	GOROKA	CWC 1_2406	Trukai medium	KERNEL
92	RA 03	Port Moresby	CSC 1	Trukai medium	KERNEL
93	RA 04	ALOTAU	CSC 1_1307	Trukai medium	KERNEL
94	RA 05	LAE	CSC 1_2107	Trukai medium	KERNEL
95	RA 06	MADANG	CSC 1_2407	Trukai medium	KERNEL
96	RA 06	MADANG	CSC 1_2407	Trukai medium	KERNEL
97	RA 081	BIALLA	CSC 1	Trukai medium	KERNEL
98	RA 092	TROPICANA	CSC 1	Trukai medium	KERNEL
99	RA 094	SOHO	CSC 1	Trukai medium	KERNEL
100	RA 02	GOROKA	CSC 3_2406	Trukai roots	KERNEL
101	RA 03	Port Moresby	CSC 3	Trukai roots	KERNEL
102	RA 05	LAE	CSC 3_2107	Trukai roots	KERNEL
103	RA 06	MADANG	CSC 3	Trukai roots	KERNEL
104	RA 07	VANIMO	CSC 3	Trukai roots	KERNEL
105	RA 08	KIMBE	CSC 3	Trukai roots	KERNEL
106	RA 081	BIALLA	CSC 3	Trukai roots	KERNEL
107	RA 091	ANDERSON	CSC 3	Trukai roots	KERNEL
108	RA 093	KERAVAT	CSC 3 (A)	Trukai roots	KERNEL
109	RA 093	KERAVAT	CSC 3 (B)	Trukai roots	KERNEL
110	RA 02	GOROKA	CSC 4_2406	Trukai roots long grain	KERNEL
111	RA 03	Port Moresby	CSC 4	Trukai roots long grain	KERNEL
112	RA 04	ALOTAU	CTC 4_1307	Trukai roots long grain	KERNEL
113	RA 05	LAE	CSC 4_2107	Trukai roots long grain	KERNEL
114	RA 06	MADANG	CSC 4	Trukai roots long grain	KERNEL
115	RA 07	VANIMO	CSC 4	Trukai roots long grain	KERNEL
116	RA 08	KIMBE	CSC 4	Trukai roots long grain	KERNEL
117	RA 081	BIALLA	CSC 4	Trukai roots long grain	KERNEL

118	RA 091	ANDERSON	CSC 4	Trukai roots long grain	KERNEL
119	RA 092	TROPICANA	CSC 4	Trukai roots long grain	KERNEL
120	RA 093	KERAVAT	CSC 4	Trukai roots long grain	KERNEL
121	RA 094	SOHO	CSC 4	Trukai roots long grain	KERNEL
122	RA 095	NH TRADING	CSC 4	Trukai roots long grain	KERNEL
123	RA 093	KERAVAT	ASA 11	Skel Ori rice	KERNEL (Poor)
124	RA 093	KERAVAT	ASA 14	Sweet and Soft	KERNEL (Poor)
125	RA 093	KERAVAT	CSC 1	Trukai medium	KERNEL (Poor)
126	RA 093	KERAVAT	BSB 6 (A)	Frangipani	MIXED
127	RA 01	HELA	BTB 13_1406	Star rice	MIXED
128	RA 03	Port Moresby	BSB 5	Super A One	MIXED
129	RA 093	KERAVAT	BSB 5 (A)	Super A One	MIXED
130	RA 092	TROPICANA	BSB 16	Sweet rice	MIXED
131	RA 02	GOROKA	BSB 8_2406	Thai Hom Mali Jasmine	MIXED
132	RA 05	LAE	BSB 8_2107	Thai Hom Mali Jasmine	MIXED
133	RA 093	KERAVAT	BSB 8 (A)	Thai Hom Mali jasmine	MIXED
134	RA 093	KERAVAT	BSB 8 (B)	Thai Hom Mali jasmine	MIXED
135	RA 02	GOROKA	BSB 7_2406	Thai Jasmine	MIXED
136	RA 04	ALOTAU	ATB 7_1307	Thai Jasmine	MIXED
137	RA 05	LAE	BSB 7_2107	Thai Jasmine	MIXED
138	RA 06	MADANG	BSB 7_2407	Thai Jasmine	MIXED
139	RA 05	LAE	BSB 6_2107	Frangipani	NEGATIVE
140	RA 06	MADANG	BSB 6_2407	Frangipani	NEGATIVE
141	RA 02	GOROKA	ASA 10_2406	Skel Jasmine	NEGATIVE
142	RA 03	Port Moresby	ASA 12	Skel rice medium grain	NEGATIVE
143	RA 094	SOHO	BSB 13	Star rice	NEGATIVE
144	RA 091	ANDERSON	BSB 5	Super A One	NEGATIVE
145	RA 08	KIMBE	BSB 16	Sweet rice	NEGATIVE
146	RA 03	Port Moresby	BSB 8	Thai Hom Mali jasmine	NEGATIVE
147	RA 03	Port Moresby	BSB 7	Thai jasmine	NEGATIVE
148	RA 03	Port Moresby	DSD 18	Tru Jasmine	NEGATIVE
149	RA 095	NH TRADING	CSC 3	Trukai roots	NEGATIVE

Table 3: Distribution of the rice samples according to the type of iron fortification method used

Kernel	Dusting	Mixed	Negative
100 (67.1%)	25 (16.8%)	13 (8.7%)	11 (7.4%)

Fig. 1: Distribution of rice samples according to the type of iron fortification method used



For further analysis of the data the 149 rice samples were sorted according to the cities. The results obtained for the various cities are presented in Tables 4 to 12. The results show the brand code and name for each rice sample and also the type of fortification used to fortify the rice samples. The summary of the results is presented in Table 13.

Table 4: Results for Hela (RA 01)

CODE	CITY	RICE CODE	BRANDS	FORTIFICANT USED
RA 01	HELA	ATA 12_1406	Skel rice medium grain	KERNEL
RA 01	HELA	BTB 13_1406	Star rice	MIXED

Table 5: Results for Hela (RA 02)

CODE	CITY	RICE CODE	BRANDS	FORTIFICANT USED
RA 02	GOROKA	BSB 5_2406	Super A One	DUSTING
RA 02	GOROKA	BSB 13_2406	Star rice	DUSTING

RA 02	GOROKA	ASA 9_2406	Skel long grain	KERNEL
RA 02	GOROKA	ASA 11_2406	Skel Ori rice	KERNEL
RA 02	GOROKA	ASA 12_2406	Skel rice medium grain	KERNEL
RA 02	GOROKA	BSB 6_2406	Frangipani	KERNEL
RA 02	GOROKA	CSC 3_2406	Trukai roots	KERNEL
RA 02	GOROKA	CSC 4_2406	Trukai roots long grain	KERNEL
RA 02	GOROKA	CWC 1_2406	Trukai medium	KERNEL
RA 02	GOROKA	CWC 2_2406	Trukai Jasmine	KERNEL
RA 02	GOROKA	BSB 7_2406	Thai Jasmine	MIXED
RA 02	GOROKA	BSB 8_2406	Thai Hom Mali Jasmine	MIXED
RA 02	GOROKA	ASA 10_2406	Skel Jasmine	NEGATIVE

Table 6: Results for Port Moresby

CODE	CITY	RICE CODE	BRANDS	FORTIFICANT USED
RA 03	Port Moresby	BSB 6	Frangipani	DUSTING
RA 03	Port Moresby	DSD 17	Tru rice	KERNEL
RA 03	Port Moresby	DSD 19	Tru value	KERNEL
RA 03	Port Moresby	ASA 9	Skel long grain	KERNEL
RA 03	Port Moresby	ASA 10	Skel jasmine	KERNEL
RA 03	Port Moresby	ASA 11	Skel Ori rice	KERNEL
RA 03	Port Moresby	ASA 14	Sweet and Soft	KERNEL
RA 03	Port Moresby	BSB 13	Star rice	KERNEL
RA 03	Port Moresby	ESE 20	Jasmin rice	KERNEL
RA 03	Port Moresby	CSC 1	Trukai medium	KERNEL
RA 03	Port Moresby	CSC 2	Trukai jasmine	KERNEL
RA 03	Port Moresby	CSC 3	Trukai roots	KERNEL
RA 03	Port Moresby	CSC 4	Trukai roots long grain	KERNEL
RA 03	Port Moresby	CSC 15	King rice	KERNEL
RA 03	Port Moresby	BSB 5	Super A One	MIXED
RA 03	Port Moresby	DSD 18	Tru Jasmine	NEGATIVE
RA 03	Port Moresby	ASA 12	Skel rice medium grain	NEGATIVE
RA 03	Port Moresby	BSB 7	Thai jasmine	NEGATIVE
RA 03	Port Moresby	BSB 8	Thai Hom Mali jasmine	NEGATIVE

Table 7: Results for Alotau

CODE	CITY	RICE CODE	BRANDS	FORTIFICANT
RA 04	ALOTAU	BSB 16_1307	Sweet rice	DUSTING
RA 04	ALOTAU	ASA 11_1307	Skel Ori rice	KERNEL
RA 04	ALOTAU	ATA 10_1307	Skel Jasmine	KERNEL
RA 04	ALOTAU	ATA 12_1307	Skel rice medium grain	KERNEL
RA 04	ALOTAU	ATA 14_1307	Sweet and Soft	KERNEL
RA 04	ALOTAU	CSC 1_1307	Trukai medium	KERNEL

RA 04	ALOTAU	CSC 2_1307	Trukai Jasmine	KERNEL
RA 04	ALOTAU	CTC 4_1307	Trukai roots long grain	KERNEL
RA 04	ALOTAU	ATB 7_1307	Thai Jasmine	MIXED

Table 8: Results for Lae

CODE	CITY	RICE CODE	BRANDS	FORTIFICANT
RA 05	LAE	BSB 13_2107	Star rice	DUSTING
RA 05	LAE	ASA 10_2107	Skel Jasmine	KERNEL
RA 05	LAE	ASA 11_2107	Skel Ori rice	KERNEL
RA 05	LAE	ASA 14_2107	Sweet and Soft	KERNEL
RA 05	LAE	CSC 15_2107	King	KERNEL
RA 05	LAE	CSC 1_2107	Trukai medium	KERNEL
RA 05	LAE	CSC 3_2107	Trukai roots	KERNEL
RA 05	LAE	CSC 4_2107	Trukai roots long grain	KERNEL
RA 05	LAE	ASA 12_2107	Skel rice medium grain	KERNEL
RA 05	LAE	BSB 7_2107	Thai Jasmine	MIXED
RA 05	LAE	BSB 8_2107	Thai Hom Mali Jasmine	MIXED
RA 05	LAE	BSB 6_2107	Frangipani	NEGATIVE

Table 9: Results for Madang

CODE	CITY	RICE CODE	BRANDS	FORTIFICANT
RA 06	MADANG	BSB 5_2407	Super A One	DUSTING
RA 06	MADANG	BSB 13	Star rice	DUSTING
RA 06	MADANG	ASA 14_2407	Sweet and Soft	KERNEL
RA 06	MADANG	ASA 11_2407	Skel Ori rice	KERNEL
RA 06	MADANG	CSC 2_2407	Trukai Jasmine	KERNEL
RA 06	MADANG	CSC 1_2407	Trukai medium	KERNEL
RA 06	MADANG	T 99_2407	Root rice	KERNEL
RA 06	MADANG	CSC 1_2407	Trukai medium	KERNEL
RA 06	MADANG	ASA 9	Skel long grain	KERNEL
RA 06	MADANG	ASA 10	Skel jasmine	KERNEL
RA 06	MADANG	ASA 12	Skel rice medium grain	KERNEL
RA 06	MADANG	CSC 3	Trukai roots	KERNEL
RA 06	MADANG	CSC 4	Trukai roots long grain	KERNEL
RA 06	MADANG	BSB 7_2407	Thai Jasmine	MIXED
RA 06	MADANG	BSB 6_2407	Frangipani	NEGATIVE

Table 10: Results for Vanimo

CODE	CITY	RICE CODE	BRANDS	FORTIFICANT
RA 07	VANIMO	BSB 6	Frangipani	DUSTING
RA 07	VANIMO	BSB 13	Star rice	DUSTING
RA 07	VANIMO	ASA 11	Skel Ori rice	DUSTING
RA 07	VANIMO	CSC 3	Trukai roots	KERNEL
RA 07	VANIMO	CSC 4	Trukai roots long grain	KERNEL
RA 07	VANIMO	ASA 12	Skel rice medium grain	KERNEL

Table 11: Results for Kimbe and Bialla

CODE	CITY	RICE CODE	BRANDS	FORTIFICANT
RA 081	BIALLA	BSB 7	Thai jasmine	DUSTING
RA 081	BIALLA	BSB 8	Thai Hom Mali jasmine	DUSTING
RA 08	KIMBE	CSC 2	Trukai jasmine	KERNEL
RA 08	KIMBE	CSC 3	Trukai roots	KERNEL
RA 08	KIMBE	CSC 4	Trukai roots long grain	KERNEL
RA 08	KIMBE	ASA 10	Skel jasmine	KERNEL
RA 08	KIMBE	ASA 11	Skel Ori rice	KERNEL
RA 08	KIMBE	ASA 12	Skel rice medium grain	KERNEL
RA 08	KIMBE	ASA 14	Sweet and Soft	KERNEL
RA 08	KIMBE	DSD 17	Tru rice	KERNEL
RA 08	KIMBE	DSD 18	Tru Jasmine	KERNEL
RA 08	KIMBE	DSD 19	Tru value	KERNEL
RA 081	BIALLA	ASA 9	Skel long grain	KERNEL
RA 081	BIALLA	ASA 11	Skel Ori rice	KERNEL
RA 081	BIALLA	ASA 12	Skel rice medium grain	KERNEL
RA 081	BIALLA	CSC 1	Trukai medium	KERNEL
RA 081	BIALLA	CSC 2	Trukai jasmine	KERNEL
RA 081	BIALLA	CSC 3	Trukai roots	KERNEL
RA 081	BIALLA	CSC 4	Trukai roots long grain	KERNEL
RA 08	KIMBE	BSB 16	Sweet rice	NEGATIVE

Table 12: Results for Rabaul (including Keravat)

CODE	CITY	RICE CODE	BRANDS	FORTIFICANT
RA 091	ANDERSON	BSB 6	Frangipani	DUSTING
RA 091	ANDERSON	BSB 7	Thai jasmine	DUSTING

RA 091	ANDERSON	BSB 13	Star rice	DUSTING
RA 092	TROPICANA	BSB 13	Star rice	DUSTING
RA 093	KERAVAT	BSB 5 (B)	Super A One	DUSTING
RA 093	KERAVAT	BSB 6 (B)	Frangipani	DUSTING
RA 093	KERAVAT	BSB 13	Star rice	DUSTING
RA 094	SOHO	BSB 6	Frangipani	DUSTING
RA 094	SOHO	BSB 8	Thai Hom Mali jasmine	DUSTING
RA 094	SOHO	BSB 5	Super A One	DUSTING
RA 093	KERAVAT	BSB 7 (A)	Thai jasmine	DUSTING (Light)
RA 093	KERAVAT	BSB 7 (B)	Thai jasmine	DUSTING (Light)
RA 094	SOHO	BSB 7	Thai jasmine	DUSTING (Light)
RA 091	ANDERSON	ASA 9	Skel long grain	KERNEL
RA 091	ANDERSON	ASA 12	Skel rice medium grain	KERNEL
RA 091	ANDERSON	ASA 14	Sweet and Soft	KERNEL
RA 091	ANDERSON	CSC 3	Trukai roots	KERNEL
RA 091	ANDERSON	CSC 4	Trukai roots long grain	KERNEL
RA 092	TROPICANA	CSC 1	Trukai medium	KERNEL
RA 092	TROPICANA	CSC 2	Trukai jasmine	KERNEL
RA 092	TROPICANA	CSC 4	Trukai roots long grain	KERNEL
RA 092	TROPICANA	ASA 9	Skel long grain	KERNEL
RA 092	TROPICANA	ASA 10	Skel jasmine	KERNEL
RA 092	TROPICANA	ASA 14	Sweet and Soft	KERNEL
RA 093	KERAVAT	ASA 9	Skel long grain	KERNEL
RA 093	KERAVAT	ASA 10	Skel jasmine	KERNEL
RA 093	KERAVAT	ASA 12	Skel rice medium grain	KERNEL
RA 093	KERAVAT	CSC 3 (A)	Trukai roots	KERNEL
RA 093	KERAVAT	CSC 3 (B)	Trukai roots	KERNEL
RA 093	KERAVAT	CSC 4	Trukai roots long grain	KERNEL
RA 094	SOHO	CSC 1	Trukai medium	KERNEL
RA 094	SOHO	CSC 2	Trukai jasmine	KERNEL
RA 094	SOHO	CSC 4	Trukai roots long grain	KERNEL
RA 094	SOHO	ASA 10	Skel jasmine	KERNEL
RA 094	SOHO	ASA 11	Skel Ori rice	KERNEL
RA 094	SOHO	ASA 12	Skel rice medium grain	KERNEL
RA 094	SOHO	ASA 14	Sweet and Soft	KERNEL
RA 095	NH TRADING	ASA 9	Skel long grain	KERNEL
RA 095	NH TRADING	ASA 10	Skel jasmine	KERNEL
RA 095	NH TRADING	ASA 11	Skel Ori rice	KERNEL
RA 095	NH TRADING	ASA 12	Skel rice medium grain	KERNEL
RA 095	NH TRADING	CSC 4	Trukai roots long grain	KERNEL
RA 093	KERAVAT	ASA 11	Skel Ori rice	KERNEL (Poor)
RA 093	KERAVAT	ASA 14	Sweet and Soft	KERNEL (Poor)

RA 093	KERAVAT	CSC 1	Trukai medium	KERNEL (Poor)
RA 092	TROPICANA	BSB 16	Sweet rice	MIXED
RA 093	KERAVAT	BSB 5 (A)	Super A One	MIXED
RA 093	KERAVAT	BSB 6 (A)	Frangipani	MIXED
RA 093	KERAVAT	BSB 8 (A)	Thai Hom Mali jasmine	MIXED
RA 093	KERAVAT	BSB 8 (B)	Thai Hom Mali jasmine	MIXED
RA 091	ANDERSON	BSB 5	Super A One	NEGATIVE
RA 094	SOHO	BSB 13	Star rice	NEGATIVE
RA 095	NH TRADING	CSC 3	Trukai roots	NEGATIVE

Table 13: Summary of rice fortification results

Name of City	City code	Number of brands	Number (%) of rice samples	Number of rice samples fortified by			
				Dusting	Kernel	Mixed	Negative
Hela	RA 01	2	2 (1.3)	0	1	1	0
Goroka	RA 02	13	13 (8.7)	2	8	2	1
POM	RA 03	19	19 (12.8)	1	13	1	4
Alotau	RA 04	9	9 (6.0)	1	7	1	0
Lae	RA 05	12	12 (8.1)	1	8	2	1
Madang	RA 06	14	15 (10.1)	2	11	1	1
Vanimo	RA 07	6	6 (4.0)	3	3	0	0
Kimbe	RA 08	11	11 (7.4)	0	10	0	1
Bialla	RA 081	9	9 (6.0)	2	7	0	0
Rabaul	RA 09	15	35 (23.5)	8	23	1	3
Keravat	RA 093	13	18 (12.1)	5	9	4	0
TOTAL			149 (100)	25	100	13	11

COMMENTS ON RICE FORTIFICATION RESULTS:

The 149 rice samples (23 brands) were purchased in eleven different cities. Detailed analysis tends to indicate that attempts were made to purchase / obtain the different brands available in the selected shop(s) in the city at the time of the visit.

The distribution shows (Table 13) that of the 149 rice samples 1.3% (2/149) was from Hela, 8.7% (13/149) from Goroka, 12.8% (19/149) from POM, 6.0% (9/149) from Alotau, 8.1% (12/149) from Lae, 10.1% (15/149) from Madang, 4.0% (6/149) from Vanimo, 7.4% (11/149) from Kimbe, 6.0% (9/149) from Bialla, 12.1% (18/149) from Keravat and 23.5% (35/149) from Rabaul.

The results obtained show that 63.1% (100/149) of the rice samples tested were fortified by kernel method, 16.8% (25/149) fortified by dusting method, 8.7% (13/149) fortified by both kernel and dusting (mixed) method and 7.4% (11/149) not fortified.

In PNG, rice is commonly washed before cooking; the major reason is to remove dust and to ensure that the rice is clean. Washing of the rice and discarding the water results in significant loss of the iron fortificant, especially if dusting method is used.

The photos in **ANNEX 3** show the effect of washing rice fortified by dusting method.

An important point to consider is that the photos in Annex 3 show the set of tests using 50g of rice with limited amount of water; this amount of rice is very low compared to the amount of rice (usually 1.0 kg or more) that is normally cooked for a meal for the family in a typical home. The result indicates that rice fortified by dusting is not recommended for use in PNG, if the objective is to improve Iron status of the vulnerable groups in population using rice as a vehicle.

The 16.8% of rice fortified by dusting plus the 7.4% with no fortificant detected indicated that a total of 24.2% (36/149) of the rice samples were not adequately fortified.

Thus, the results show that despite the existing legislation for fortification of white rice, about 25% of the rice samples (brands) sold in the 11 cities were not appropriately fortified with Iron. Rice fortification legislation in PNG could be improved by specifying suitable fortification methodology, which is fortification by kernel method, NOT dusting.

The results further underscore the urgent need to advocate for the inclusion of Iron fortification of wheat flour in the PNG Food Fortification policy. In PNG, the use of wheat flour in food preparation does not include washing the flour before cooking; thus, Iron fortification of flour has a greater potential in improving the Iron status of the population, compared to rice (which is commonly washed before cooking).

FORTIFICATION OF SALT WITH IODINE:

A total of 29 salt samples were in batch 1 and 21 in batch 2. The two batches were combined for data analysis. The WYD Iodine checker was used to quantitatively determine the Iodine content in the 50 salt samples from the 7 cities. The data obtained is presented in the Excel Spreadsheets: "Atch 2 Iodine in salt NDOH 2019".

The 50 salt samples were sorted using the brand codes and names provided by the EHO NDOH. There were 16 different brands of salt. The number and frequency distribution of the 50 salt samples according to their brands are presented in Table 14.

Brands E 2, F 1 and I 4 had the highest frequency of 14.0% (7/50), followed by brands D 3 with frequency of 12.0% (6/50). The frequencies of the other brands are shown in Table 14.

The results obtained for the iodine content in all the salt samples from the 7 cities were sorted according to the cut-off points in the PNG Salt Legislation. The cut-off points used are:

- Range indicating “No Iodine”: Iodine below 5.0mg/kg
- Range indicating “Inadequate iodine content”: Iodine 5.0 to 29.9mg/kg;
- Range indicating “Adequate iodine content”: Iodine 30.0 to 50.0mg/kg;
- Range indicating “Excess iodine content”: Iodine above 50.0mg/kg.

Table 14: Distribution of the salt samples according to brand codes, brand names and frequency of the brands

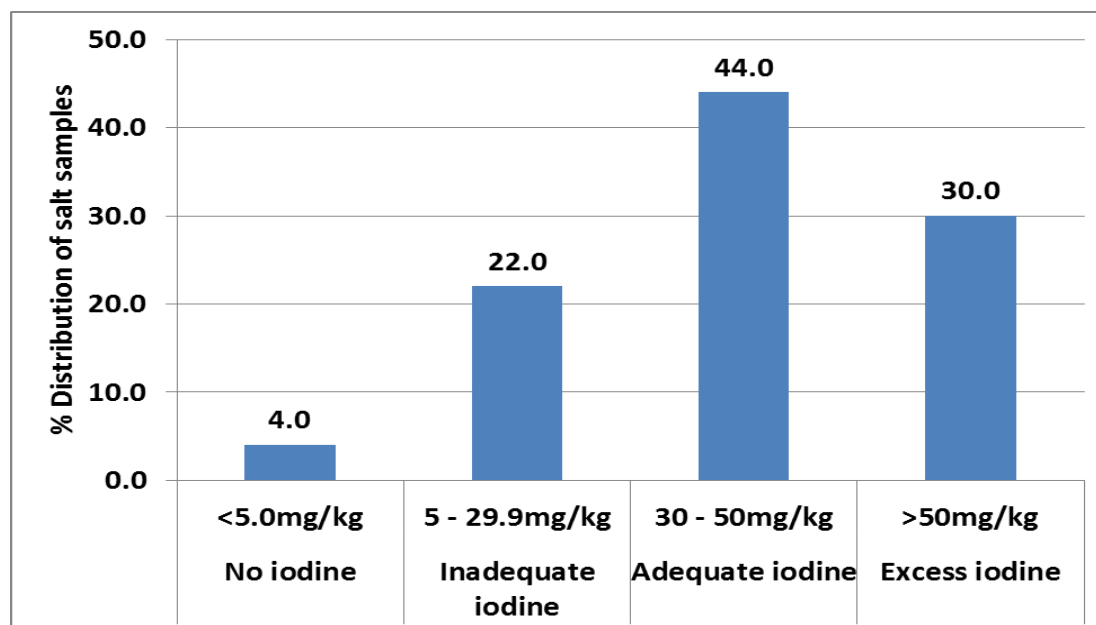
Brand codes	Brand names	Number of salt samples	Frequency
T 7	Black & Gold	1	2.0%
S 16	Crystal salt	1	2.0%
M 10	Daily fresh	1	2.0%
J 5	Everyday fresh	1	2.0%
F 7	Ezy cook	2	4.0%
L 9	Highlands	2	4.0%
I 4	Jumbo	7	14.0%
K 6	Lion	2	4.0%
N 11	Mama's salt	4	8.0%
P 13	Rait salt	1	2.0%
R 15	Saxa table salt	1	2.0%
O 12	Sazza fine salt	3	6.0%
G 8	Sofa tuzu	3	6.0%
D 3	Star salt	6	12.0%
E 2	Super salt	7	14.0%
F 1	Tru cook	7	14.0%
D 13	-----	1	2.0%
TOTAL		50	100.0%

Analysis of the 50 salt samples shows that the iodine content was below 5.0mg/kg in 4.0% (2/50) of the salt samples. The iodine content was inadequate in 22.0% (11/50) of salt samples, adequate in 44.0% (22/50) and excess in 30.0% (15/50) of the salt samples.

The results is further illustrated in Fig 2 showing the percent distribution of the iodine content in the 50 salt samples using the cut-off points recommended in the PNG Salt Legislation and the format recommended in the UNICEF guidelines for presentation of results for salt iodization.

For further analysis of the data the 50 salt samples were sorted according to the cities. The data analysis can be checked in the Excel Spreadsheets “Attch 2 Iodine in salt NDOH 2019”. The results obtained for each of the seven cities are summarized in Table 15.

Fig 2: % Distribution of the iodine content in the 50 salt samples from the seven cities



The iodine content was above 5.0mg/kg in salt samples from five cities. However, in Kimbe and Rabaul the iodine content was below 5.0mg/kg in 10.0% (1/10) and 16.7% (1/6) of the salt samples respectively. The iodine content was inadequate in 25% (2/8) of salt from Goroka, 12.5% (1/8) from Lae, 30% (3/10) from Madang, 40% (4/10) from Kimbe and 16.7% (1/6) from Rabaul. The percent of salt samples with adequate amount and excess amount of iodine are presented in Table 15.

The results in Table 15 also indicate the percent of cities with adequately iodized salt. It has been suggested that over 90% of salt samples sold in the markets should be adequately iodized salt according to the PNG Standard.

This criterion has not been fulfilled in any of the seven cities. The lowest was in the Rabaul with 33.3% (2/6) of the salt samples adequately iodized according to PNG Standard; this is followed by Goroka with 37.5% (3/8), Kimbe with 40% (4/10) and the other provinces with 50% each. Thus the adequately iodized salt coverage was 50% in four cities at the time of this project.

Table 15: % (n) Distribution of iodine content in salt from the cities according to cut-off points in PNG salt legislation

Codes	Names of Cities	Number of samples	Number of Brands	Percent (n) of salt samples with iodine content:			
				<5.0mg/kg	Inadequate: 5 – 29.9mg/kg	Adequate: 30 – 50mg/kg	Excess: > 50mg/kg
SA 01	Hela	2	2	0	0	50% (1)	50% (1)
SA 02	Goroka	8	7	0	25% (2)	37.5% (3)	37.5% (3)
SA 04	Alotau	6	4	0	0	50% (3)	50% (3)
SA 05	Lae	8	6	0	12.5% (1)	50% (4)	37.5% (3)
SA 06	Madang	10	7	0	30% (3)	50% (5)	20% (2)
SA 08	Kimbe	10	10	10% (1)	40% (4)	40% (4)	10% (1)
SA 09	Rabaul	6	3	16.7% (1)	16.7% (1)	33.3% (2)	33.3% (2)

The low percentage of adequately iodized salt in the seven cities should be of concern to the authorities because of the severe consequence of iodine deficiency on pregnant and lactating mothers and on the developing brains of neonates [12 – 14].

One of the generally acceptable concepts is that it is better to consume salt containing more iodine than less iodine [12]. Table 16 shows the recalculation of the results for availability of iodized salt in the seven cities. This was done by taking the sum of the salt samples with adequate and excess iodine. The results obtained are presented in Table 16.

The results show that the criterion was still not fulfilled by five of the seven cities, because the combined results were still below the 90% recommended coverage. Kimbe was the lowest with 50% (5/10), followed by Rabaul with 66.6% (4/6), Madang with 70% (7/10), Goroka with 75% (6/8), and Lae with 87.5% (7/8).

Table 16: Combined % distribution of adequate and excess iodine content in salt from the seven cities based on the cut-off points in PNG salt legislation

Codes	Names of Cities	Number of salt	Number of brands	Percent of salt samples with iodine content:				Combined (mg/kg)
				<5.0mg/kg	Inadequate: 5–29.9mg/kg	Adequate: 30–50mg/kg	Excess: >50mg/kg	
SA 01	Hela	2	2	0	0	50%	50%	100%
SA 02	Goroka	8	7	0	25%	37.5%	37.5%	75.0%
SA 04	Alotau	6	4	0	0	50%	50%	100%
SA 05	Lae	8	6	0	12.5%	50%	37.5%	87.5%
SA 06	Madang	10	7	0	30%	50%	20%	70.0%
SA 08	Kimbe	10	10	10%	40%	40%	10%	50.0%
SA 09	Rabaul	6	3	16.7%	16.7%	33.3%	33.3%	66.6%

COMMENTS ON SALT IODIZATION RESULTS:

The results obtained for the salt iodization indicated that less than 55% of adequately iodized salt was available in shops in the seven cities at the time of collection of the samples. Adequate salt iodization remains the main strategy for achieving sustained iodine deficiency disorders (IDD) control, and global experience has demonstrated that the iodization of food grade salt is the most equitable, effective and sustainable strategy to ensure optimal iodine nutrition for all population groups [12 – 14].

To ensure effective and sustainable food fortification program, it is important for government to ensure importation of only salt that meet national standards. Consumption of adequate and safe nutritious meals is the best form of preventive medicine and a guarantee of good health for the community. It is needed to improve the health and lives of all Papua New Guineans, and to become a “Smart, Wise, Fair, Healthy and Happy Society” (Vision 2050).

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ANNEX 1

RICE AND SALT SAMPLES AND CODE NUMBERS FROM NDOH RECEIVED

RICE (RA) ANALYSIS: CITY CODES FOR RICE
01 – HELA
02 – GOROKA
03 – PORT MORESBY
04 - ALOTAU
05 – LAE
06 - MADANG
07 - VANIMO
08 - KIMBE
081 – BIALLA
09 – RABAUL
091 – ANDERSON
092 – TROPICANA
093 – KERAVAT
094 – SOHO,
095 – NH TRADING

COMPANY CODE
A - GOODMAN FIELDERS
B - HOMESTEAD
C - TRUKAI INDUSTRIES
D - KENDO
E – STOP & SHOP

LOCATION CODE
W – WHOLESALE
S - SUPERMARKET
T - TRADESTORE

BRAND CODES
C1 - TRUKAI MEDIUM
C 2 - TRUKAI JASMINE
C 3 - TRUKAI ROOTS
C4 - TRUKAI ROOTS LONG GRAIN
B5 - SUPER A ONE

B6 - FRANGIPANI
B7 - THAI JASMINE
B8 - THAI HOM MALI JASMINE
A9 - SKEL LONG GRAIN
A10 - SKEL JASMINE
A11 - SKEL ORI RICE
A12 - SKEL RICE MEDIUM GRAIN
B13 - STAR RICE
A14 - SWEET AND SOFT
C15 - KING
B16 - SWEET RICE
D17 - TRURICE
D18 - TRU JASMINE
D19 - TRUVALUE
E20 -JASMINE RICE
**99TNON (UNLABLED ROOTS RICE)

RICE SAMPLES RECEIVED IN THE LABORATORY ON THE 6th AUGUST 2019

	NAME OF CITY	SAMPLE NUMBER	SAMPLE CODE
1	HELA	RA01	ATA12
2	HELA	RA01	BTB13
3	HELA	RA01	BTB13
		3	
4	GOROKA	RA02	CWC1
5	GOROKA	RA02	CWC2
6	GOROKA	RA02	CSC3
7	GOROKA	RA02	CSC4
8	GOROKA	RA02	BSB5
9	GOROKA	RA02	BSB6
10	GOROKA	RA02	BSB7
11	GOROKA	RA02	BSB8
12	GOROKA	RA02	ASA9
13	GOROKA	RA02	ASA10
14	GOROKA	RA02	ASA11
15	GOROKA	RA02	ASA12
16	GOROKA	RA02	BSB13
		13	
17	ALOTAU	RA04	CSC1
18	ALOTAU	RA04	CSC2
19	ALOTAU	RA04	CTC4
20	ALOTAU	RA04	ATB7
21	ALOTAU	RA04	ATA10
22	ALOTAU	RA04	ASA11
23	ALOTAU	RA04	ATA12
24	ALOTAU	RA04	ATA14
25	ALOTAU	RA04	BSB16
		9	

26	LAE	RA05	CSC1
27	LAE	RA05	CSC3
28	LAE	RA05	CSC4
29	LAE	RA05	BSB6
30	LAE	RA05	BSB7
31	LAE	RA05	BSB8
32	LAE	RA05	ASA10
33	LAE	RA05	ASA11
34	LAE	RA05	ASA12
35	LAE	RA05	BSB13
36	LAE	RA05	ASA14
37	LAE	RA05	CSC15
		12	
38	MADANG	RA06	CSC1
39	MADANG	RA06	CSC1
40	MADANG	RA06	CSC2
41	MADANG	RA06	BSB5
42	MADANG	RA06	BSB6
43	MADANG	RA06	BSB7
44	MADANG	RA06	ASA11
45	MADANG	RA06	ASA14
46	MADANG	RA06	99T NON
		9	
BATCH 1: RICE RECEIVED (400grams each)			

RICE SAMPLES RECEIVED ON THE 24th SEPTEMBER 2019

#	SAMPLE NUMBER	SAMPLE CODE
01	RA03	DSD17
02	RA03	DSD18
03	RA03	DSD19
04	RA03	ASA09
05	RA03	ASA10
06	RA03	ASA11
07	RA03	ASA12
08	RA03	ASA14
09	RA03	BSB05
10	RA03	BSB06
11	RA03	BSB07
12	RA03	BSB08
13	RA03	BSB13
14	RA03	ESE20
15	RA03	CSC01
16	RA03	CSC02
17	RA03	CSC03
18	RA03	CSC04
19	RA03	CSC15
20	RA06	BSB13

21	RA06	ASA09
22	RA06	ASA10
23	RA06	ASA12

24	RA07	CSC03
25	RA07	CSC04
26	RA07	BSB06
27	RA07	BSB13
28	RA07	ASA11
29	RA07	ASA12
30	RA08	CSC02
31	RA08	CSC03
32	RA08	CSC04
33	RA08	BSB16
34	RA08	ASA10
35	RA08	ASA11
36	RA08	ASA12
37	RA08	ASA14
38	RA08	DSD17
39	RA08	DSD18
40	RA08	DSD19
41	RA081	ASA09
42	RA081	ASA11
43	RA081	ASA12
44	RA081	CSC01
45	RA081	CSC02
46	RA081	CSC03
47	RA081	CSC04
48	RA081	BSB07
49	RA081	BSB08

50	RA091	ASA09
51	RA091	ASA12
52	RA091	ASA14
53	RA091	CSC03
54	RA091	CSC04
55	RA091	BSB05
56	RA091	BSB06
57	RA091	BSB07
58	RA091	BSB13
59	RA092	CSC01
60	RA092	CSC02
61	RA092	CSC04
62	RA092	ASA09
63	RA092	ASA10
64	RA092	ASA14
65	RA092	BSB13
66	RA092	BSB16

67	RA093	ASA09
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68	RA093	ASA10
69	RA093	ASA11
70	RA093	ASA12
71	RA093	ASA14
72	RA093	CSC01
73	RA093	CSC03 (a)
74	RA093	CSC03 (b)
75	RA093	CSC04
76	RA093	BSB05 (a)
77	RA093	BSB05 (b)
78	RA093	BSB06 (a)
79	RA093	BSB06 (b)
80	RA093	BSB07 (a)
81	RA093	BSB07 (b)
82	RA093	BSB08 (a)
83	RA093	BSB08 (b)
84	RA093	BSB13

85	RA094	BSP06
86	RA094	BSP07
87	RA094	BSP08
88	RA094	BSP13
89	RA094	CSC01
90	RA094	CSC02
91	RA094	CSC04

92	RA094	ASB05
93	RA094	ASA10
94	RA094	ASA11
95	RA094	ASA12
96	RA094	ASA14
97	RA095	ASA09
98	RA095	ASA10
99	RA095	ASA11
100	RA095	ASA12
101	RA095	CSC03
102	RA095	CSC04

BATCH 2: RICE RECEIVED (400 grams each)

SALT SAMPLES AND CODE NUMBERS

(SA) SALT ANALYSIS: CITY CODES
01 - HELA
02 - GOROKA –(L) PAPINDO (M) SENGOA
03 - PORT MORESBY
04 - ALOTAU – (A) MUTZIAS (B) HAGITA
05 - LAE – MAIN MARKET (D) NADZAB (E) FURAMA (F) SUPREME (G) KAMKUMUAG
06 - MADANG – (H) PAPINDO MODILON (I) PAPINDO TOWN (J) ANDERSON (K) JZ
07 - VANIMO
08 - KIMBE
09 - RABAU

COMPANY CODES
D - HOMESTEAD CO- OPERATION
E - KENDO LIMITED
F - UNISION PACIFIC
G - ZER YAN SAN. VET TIC A,S
H - GLORIA MARKETING
I - SUPERVALUE STORES LTD
J - ATLAS IMPEX
K - ROYAL KINGDOM INDUSTRY CORP. LTD
L - SUN INTERNATIONAL
M - DATUM HINDUSTAN PVT LTD
N - MAM'S
O - LAM'S TRADING
P - A.C.C. AUSTPAC
Q - SALPAK P/L
R - PNG SALT INDUSTRIES LTD
S – AUSTRALIA ASIA/PACIFIC

LOCATION CODES
W - WHOLESALE
S - SUPERMARKET
T - TRADE STORE

SALT BRAND CODES
F - TRU COOK
E2 - SUPER
D3 - STAR
I4 - JUMBO
J5 - EVERYDAY FRESH
K6 - LION
F7 - EZY COOK
G8 - SOFRA TUZU
L9 - HIGHLANDS
M10 - DAILY FRESH
N11 - MAMA'S SALT
O12 - SAZZA FINE SALT
P13 - RAIT SALT
Q14 - SALINA
R15 - SAXA TABLE SALT
S16 - CRYSTAL
T17 - BLACK & GOLD
D13

SALT SAMPLES RECEIVED IN THE LABORATORY ON 6th AUGUST 2019

#	NAME OF CITY	SAMPLE NUMBER	SAMPLE CODE
01	HELA	SA01	ETE2
02	HELA	SA01	DTD3
		2	
03	GOROKA	SA02	MFSF1
04	GOROKA	SA02	LESE2
05	GOROKA	SA02	MDSD3
06	GOROKA	SA02	LESK6
07	GOROKA	SA02	LESGG8
08	GOROKA	SA02	MLSL9
09	GOROKA	SA02	LESMI4
10	GOROKA	SA02	LESII4
		8	
11	ALOTAU	SA04	AFTF1
12	ALOTAU	SA04	BETE2
13	ALOTAU	SA04	AETE2
14	ALOTAU	SA04	ADTD3
15	ALOTAU	SA04	BDTD3
16	ALOTAU	SA04	ANN11
		6	
17	LAE	SA05	SF1
18	LAE	SA05	FFSF1
19	LAE	SA05	FESE2
20	LAE	SA05	CDSD3

21	LAE	SA05	FSD3
22	LAE	SA05	EJSJ5
23	LAE	SA05	GLSL9
24	LAE	SA05	CNSN11
		8	
25	MADANG	SA06	IKSK6
26	MADANG	SA06	HFSF7
27	MADANG	SA06	IGSG8
28	MADANG	SA06	KHSO12
29	MADANG	SA06	JISI4
		5	

SALT SAMPLES RECEIVED ON THE 28/09/2019

#	Name of City	SAMPLE NUMBER	SAMPLE CODE
01		SA06	ISI4
02		SA06	NSN11
03		SA06	HSO12
04		SA06	OSP13
05		SA06	TSD13
06		SA08	FSF1
07		SA08	ESE2
08		SA08	ISI4
09		SA08	FSF7
10		SA08	GSG8
11		SA08	MSM10
12		SA08	NSN11
13		SA08	HSO12
14		SA08	SQR12
15		SA08	SQR15
16		SA08	RSS16
17		SA091	ESE2
18		SA091	SST17
19		SA092	FSF1
20		SA094	FSF1
21		SA095	ISI4 (a)
22		SA095	ISI4 (b)

SALT RECEIVED (200gm each) 28/09/2019

ANNEX 2



**RICE NOT FORTIFIED WITH IRON
(NEGATIVE)**



RICE FORTIFIED BY KERNELS



RICE FORTIFIED BY DUSTING



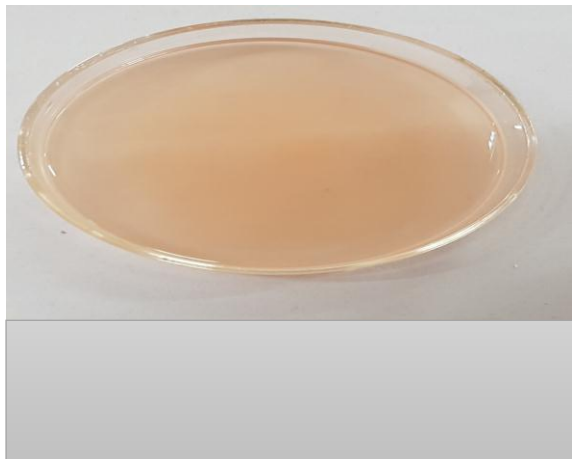



**MIXED: RICE FORTIFIED BY
DUSTING & KERNELS (The kernels**

ANNEX 3

Results of Washed and Unwashed Rice:

The photos show comparison between unwashed and washed rice fortified by dusting method. As stated Papua New Guineans tend to wash their rice until water is clear, these photos show how washing can remove the fortificant from the rice, especially when dusting method is used.

<p>Unwashed Rice fortified by dusting method tested for Iron (Positive)</p>	<p>Same rice washed once then tested for Iron. Ratio of rice to water was (1 cup of rice + 4 cups of water): Test shows very low presence of Iron</p>
	
	
<p>Water drained from rice after washing once. Show presence of iron in the water</p>	<p>Rice washed twice with water. Shows significant loss of Iron fortificant</p>

Report presented by
 Assoc. Prof. Victor J Temple
 Coordinator Micronutrient Research Laboratory
 Division of Basic Medical Sciences, School of Medicine and Health Sciences, University of Papua New Guinea
www.victorjtemple.com; templevj@upng.ac.pg; templevictor@gmail.com

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