final report

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Product and Process Development of Intermediate Moisture and Dried Beef Products

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Contents:

Recommendations: *Process Modifications*

Minced Products

A 3 mm mincing plate be used instead of the double pass through the 5 mm plate for products made with minced beef viz. stickettes and reformed shredded jerky;

Minced products utilise a combination of mincing and blending technologies as opposed to the trialled mincing and cutting technologies.

Massaged Products

The massager be placed within the storage environment 12 - 18 hours before use to allow the unit to equilibrate in temperature.

Powdered Products

Emulsification be conducted after preheating;

Preheating be conducted within the Stephan bowl cutter through live steam incorporation;

The method and timing of the addition of seasonings be reviewed to maximise flavour retention.

Drying Conditions - All Products

Until optimisation trials can be conducted; the dehumidified air heat pump drying be conducted at 55 °C for stickette, strip, chip and cake jerky production;

Until optimisation trials can be conducted; the dehumidified air heat pump drying of cube jerky and jerky products thicker than 5 mm be conducted at 48 °C;

All drying be scheduled to run overnight (approximately 12 hours) from late afternoon; excepting the Tropicali beef jerky chip which has an approximate drying time of 6 hours.

Trial Sampling and Preparation for in progress Water Activity assessment

1 unit from each tray be removed, amalgamated and reduced to < 2mm diameter (via food processor) prior to the conductance of water activity investigations.

Formulatory Modifications

All Products

Sodium nitrite (when used) be added at 200 ppm w/w in the undiluted wet product;

Outback Tucker stickette be reformulated to effectively bind the water (at the processing temperature) within the nonmeat ingredients.

2.1 Development of processing techniques for stickette style beef jerky

Background:

Previous attempts at producing stickette style jerky product highlighted the need to utilise a small diameter filling nozzle, reduced meat particle size and a drying time less than 26.5 hours.

Mr.Kirk requested the processing time to be less than 8 hours wherever possible.

Aim:

Develop processing techniques for stickette style beef jerky.

Report:

A collagen casing was located from Devro that had a reported average stuffed diameter of 13 mm +/- 1 mm. Modifications to a sausage filler nozzle were undertaken to reduce the internal diameter to approximately 7 mm and the external diameter to approximately 10 mm.

Investigations were conducted into several meat processing technologies which resulted in a double mincing step being used in combination with the cutting and blending operations in the bowl cutter. The mincing plate used contained holes with a 5 mm diameter.

Temperature control was again highlighted as an important control parameter with the stickettes *fatting out* during filling due to pressures and temperature inputs which resulted in a heating of the sausage emulsion from <4 °C to 20 °C.

Product was successfully filled and partially dried in order to predict the time of drying. After 5 hours 40 minutes at 48 °C the stickettes were heavily wrinkled and had a relatively high water activity of 0.88. The rate of water activity decline suggested that a drying time in excess of 8 hours would be required at 48 °C. The projected drying time was outside of Mr Kirk's request and as such the drying temperature for the remaining trials was increased to 55 °C.

As a result of this trial work and equipment modification the stickette methodologies for sub-projects 2.3 and 2.5 were specified.

2.2 Analyse samples of Taiwanese dried beef jerky

Background:

Mr R.Kirk and Mr D.Soutar (Horizon Holdings) and Mr F.Wong (Yeuanyeou Enterprise Co., Ltd.) submitted various samples of Taiwanese jerky products (29/9/94). Three representatives of these samples were chosen for chemical analysis.

Mr Wong described a *typical* Taiwanese process of preparing beef jerky whereby the meat is marinaded, sun (or air) dried, sliced and packed for consumption. Ingredients within the marinade could be varied to suit taste. It was suggested that sodium nitrite was used at a level of 200 ppm before cooking. The use of potassium sorbate was apparently widespread as a preservative against moulds and yeasts. Suggested levels of salt and sugar were offered for the marinate recipe. The use of *moisture absorbers* was also stated as being widely used. Gas flushing was not used in the production of Taiwanese jerky according to Mr Wong.

Aim:

To confirm by chemical analysis the salient production parameters of Taiwanese jerky.

Analyses:

Table 1. Results of chemical analysis on three samples of Taiwanese dried beef products.

Product	*Moisture (%)*	*Fat (%)*	*Salt (%)*	*pH*	*Water Activity*	*Sodium nitrite*	*Total Sugars (%)*
Fruity Jerky Strips	22.2	4.3	2.6	5.1	0.71	ud*	43.6
Salty Jerky Strips	17.8	8.9	2.3	5.6	0.64	ud	30.5
Salty Finger-strip jerky	19.0	2.4	3.2	5.5	0.64	ud	44.3

* Unable to Detect

2.2 Analyse samples of Taiwanese dried beef jerky (cont'd)

Table 2. Results of total sugar analysis on three samples of Taiwanese dried beef products.

Product	*Fructose (%)*	*Glucose (%)*	*Sucrose (%)*	*Maltose (%)*	*Total Sugars (%)*
Fruity Jerky Strips	2.1	0.2	41.3	nd[1]	43.6
Salty Jerky Strips	0.2	0.2	30.1	nd	30.5
Salty Finger-strip jerky	0.5	nd	43.8	nd	44.3

[1] Not Detected

Report:

Very little of the information on the packages of Taiwanese beef jerky was printed in English. That which was, indicated a shelf life of between 60 days and 6 months. This is significantly below all markets previously reviewed.

One of the assayed packs (salty jerky) contained an oxygen absorber whilst two of the three contained formed plastic trays within the packs. No moisture absorbers were detected.

All samples were apparently prepared from natural muscle cuts i.e. there was no evidence of mincing and reforming. Many of the strips had gristle through them suggesting the use of poorer quality meat cuts i.e. those with a high content of *heavy* connective tissue. The final fat content of the products indicate that a raw material of 95 CL or better was used. Aside from the finger-strips there was no evidence of sizing of the strips of meat.

The presence of fructose as well as sucrose indicates that a mixture of fruit juice and sugar had been used within the marinate. There appears to be at least two different styles of marinate used with one producing approximately 2.9% salt and 44 % total sugars and another producing 2.5% salt and 30 % total sugars in the final jerky. However, both jerky types contained fruit juice within the marinate.

Sodium nitrite was unable to be detected as there was marked interference within the assay; presumably through a chemical reaction involving one or more of the marinate ingredients. This interference has previously been detected when fruit juices have been used within the jerky marinate.

The moisture level for all submitted jerky samples was approximately 20 % in the final product.

Generally, the form of the final product and the chemical data support Mr Wong's methodology with the following exception; the use of moisture absorbers was not detected whilst the use of oxygen absorbers was detected.

2.2 Analyse samples of Taiwanese dried beef jerky (cont'd)

Conclusions:

The apparently desired water activity for the Taiwanese beef jerky market ranges between 0.60 and 0.70.

The apparently desired fat level of the raw beef for the Taiwanese beef jerky market ranges between 95 CL or better. Poorer quality cuts, i.e. containing a high degree of connective tissue, are apparently acceptable.

The Taiwanese jerky market is striated into salty and fruity jerky styles of products which apparently have differences in the finished levels of both the salt and sugar contents. The salty jerky appears to have 2.5 % salt and 30 % sugar whilst the fruity jerky appears to have 2.9 % salt and 44 % sugar in the final product.

Product with substantially less than 1 year shelf life is within the Taiwanese beef jerky market.

2.3 Produce a batch run of Japanese style beef jerky stickette

Background:

Several samples of beef jerky were previously provided and assayed (Stage 2 - Supplementary Report - Nov.'94) - one of these was a stickette style jerky. Mr Kirk requested that a similar product be developed.

The methodology and equipment modification were determined in Stage 2.1.

Aim:

Produce a batch run of Japanese style beef jerky stickette.

Recipe:

Table 3. Recipe for Japanese Style (Eastern) Beef Jerky Stickettes.

Ingredient	*Supplier*	*Percentage (w/w)*
Salt (dairy)	Lindgren	1.08
Sugar (brown)	CSR	3.00
Pepper on Salt	Lindgren	0.20
Vinegar (white)	-	3.00
Soy Sauce (Japanese)	GroMarket	7.00
Sodium Nitrite	Lindgren	0.02
85 CL Beef Trims	IMTP (Wholesale)	85.70
TOTAL		100.00

Methodology:

·1· Separately weigh all meat and nonmeat ingredients;
·2· Mince meat through 5 mm plate (twice);
·3· Transfer to Stephan bowl cutter;
·4· Add dry ingredients to Stephan bowl cutter;
·5· Cut at low speed;
·6· Add liquid ingredients to bowl cutter;
·7· Cut at high speed until homogenous and no free liquid is present;
·8· Transfer to sausage filler with modified nozzle;
·9· Fill into Devro 13A16 Meat Snacks Casings;
·10· Tie ends and arrange on mesh trays;
·11· Dry at 55 °C° to water activity of 0.70 - 0.80;
·12· Transfer to plastic bags and allow to cool and equilibrate in chiller;

2.3 Produce a batch run of Japanese style beef jerky stickette (cont'd)

Methodology: (cont'd)

·13· Cut to desired lengths (45 mm);
·14· Pack in 100 g packs under Nitrogen flushing in barrier pouches (Trigon - Tufflex 150 x 200 mm).
• Dehumidified air heat pump drier, maximum air velocity.

Report:

The continued cutting of the meat emulsion within the bowl cutter was found to be crucial as free liquid filled into casings resulted in a heavily wrinkled product of uneven thickness.

The final water activity was 0.79 whereas the reading taken to end the drying run was 0.75. This suggests that either there was an uneven distribution of ingredients through the product, the casing varied dramatically in thickness or there is a discrepancy within the method of sampling and assaying the product during production and during confirmation analysis. The variation due to temperature at the time of assaying is another complication that could not be adequately investigated during this project.

Variation within the casing has been tentatively ruled out as the casing is not known to vary more than 2 mm from the manufactured diameter. Superficial investigations into the method of preparation of the sample did result in significantly different results on the same sample unit and is believed to have been the cause for this discrepancy.

The relatively high water activity was also expressed in a slightly high moisture level and a conversely slightly low fat content as opposed to the sample assayed from the Japanese market (Stage 2 - Supplementary Report - Nov.'94). Further drying would appear to have produced a stickette of similar fat and moisture levels as the Japanese market sample.

The salt content used appears to have been to high for the intended market with a level of approximately 5 % achieved with further drying recommended. This contrasts against the 3 - 4.5 % found within the Japanese market samples (Stage 2 - Supplementary Report - Nov.'94).

The low level of sodium nitrite was expected and falls within typical Australian industry levels for cured manufactured meat products.

The total drying time was 15 hours at 55 °C and the product was not deemed to be dry enough after review of the analyses. It is expected that to achieve a water activity below 0.75 that the drying time required would be between 18 and 20 hours at 55 °C.

The bacterial load was relatively high and reflects the high degree of handling required during the filling (hand linking) and loading onto mesh trays. Careful consideration as to commercial production techniques should alleviate this excessive handling and thereby contribute to a reduction in overall bacterial load.

The relatively high yield of this product when compared to the Stage 2.5 (reformulated) stickette is mainly due to a higher level of solids being present in the Japanese style product and the higher retention of overall moisture.

Conclusions:

85 CL beef is an acceptable raw material for this product;

The current level of sodium nitrite be maintained in future recipes;

Further drying (> 16 hours at 55 °C) and modification to the salt level is required to better align the product with the Japanese market;

Sampling plans and analysis pretreatments need to be modified such that the in progress assays become more accurate for the batch as a whole;

Consideration be given to the introduction of mechanical linking or other automation within the commercial production system.

2.4 Produce a batch run of Taiwanese style beef jerky strips

Background:

The methodology and ingredients within the marinate were derived from discussions with Mr F.Wong (29/9/94) and the results of Stage 2.2. An alteration to the methodology proposed by Mr Wong was the cutting of the meat prior to drying to lower the nett processing time. The choice of meat was narrowed to chuck following the interpretation of Stage 2.2. Due to the similarities between the strip and cube product, all of the chuck was marinated and cooked at the same time. Then each cut was sliced or diced as per the need of the products and the limitations of each beef cut.

Aim:

Produce a batch run of Taiwanese style beef jerky strips.

Recipe:

Table 4. Recipe for Taiwanese Style (Fruity) Marinade.

Ingredient	*Supplier*	*Percentage (w/w)*
Salt (dairy)	Lindgren	2.650
Sugar (brown)	CSR	30.916
Pepper on Salt	Lindgren	0.919
Ginger on Salt	Lindgren	1.767
Garlic on Salt	Lindgren	1.837
Pineapple Juice (unsweetened)	Golden Circle	35.333
Potassium Sorbate	Food Chem Trading	0.795
Soy Sauce (Japanese)	GroMarket	13.250
Sodium Nitrite	Lindgren	0.079
Water		12.455
TOTAL		100.000

Methodology:

·1· Ensure all ingredients are chilled (2-4 °C);
·2· Cut meat to approximately 18 cm x 18 cm x 24 cm;
·3· Weigh meat;
·4· Separately weigh and combine all marinate ingredients;

2.4 Produce a batch run of Taiwanese style beef jerky strips (cont'd)

Methodology: (cont'd)

·5· Add meat to tumbler massager;
·6· Add desired amount of marinate (30 %);
·7· Massage under vacuum for 18 hours with 10 minutes on + 10 minutes rest (approximately 2000 revolutions);
·8· Transfer meat to steam jacketed water bath @ 90-95 °C;
·9· Cook to an internal temperature of 75-85 °C (3 hrs);
·10· Transfer meat to refrigerator and allow to cool to 0-4 °C;
·11· Slice at 5 mm +/- 1 mm;
·12· Place on mesh trays;
·13· Dry at 55 °C* to water activity of 0.60 - 0.70;
·14· Transfer to plastic bags and allow to cool and equilibrate in chiller;
·15· Pack in 100 g packs under Nitrogen flushing in barrier pouches (Trigon - Tufflex 150 x 200 mm).

* Dehumidified air heat pump drier, maximum air velocity.

Report:

Both the Taiwanese style strip and cube jerky were processed at the same time and were combined during equilibration. The total drying time was 11.75 hours and at the time the strip was removed it had a water activity of 0.72. It is suggested that a drying time of 15 hours would be required to achieve a water activity between 0.60 and 0.70 for this strip product.

Again a discrepancy between real process time monitoring of water activity and ex-production assaying was detected. After equilibration, in contact with the Taiwanese style jerky cubes, it was found that the water activity of the strips had altered to 0.79; presumably as a result of moisture transfer between the cubes and the strips.

The final moisture content was similar to that previously assayed (Stage 2.2). However, the salt content was lower than desired whilst the final pH, water activity and fat were above the levels determined from actual market samples (Stage 2.2). This suggests that a great deal of recipe modification is required for this product to be brought in line with Taiwanese market samples.

The method of cooking and slicing was readily incorporated and did contribute to significantly lower bacterial loads within the products as compared to other products made during these Stage 2 investigations.

The product did have gristle present. The trimming of the chuck to 90 CL may become necessary in future runs due to the distribution of fat in the beef cut.

2.4 Produce a batch run of Taiwanese style beef jerky strips (cont'd)

Conclusions:

Beef chuck is an acceptable meat raw material for this product;

Further drying (> 12 hours at 55 °C) and modification to the recipe is required to better align the product with the Taiwanese market;

Sampling plans and analysis pretreatments need to be modified such that the in progress assays become more accurate for the batch as a whole;

2.5 Produce a batch run of reformulated stickette style beef jerky

Background:

Previous attempts to produce a stickette product using the Tropicali flavour profile highlighted a need to alter the recipe in order to remove several sour notes that developed (Stage 1.b).

Discussions with Mr Kirk resulted in the Outback Tucker marinate flavour profile being used.

Aim:

Produce a batch run of reformulated stickette style beef jerky.

Recipe:

Table 5. Recipe for reformulated (Outback Tucker) beef jerky stickettes.

Ingredient	*Supplier*	*Percentage (w/w)*
Salt (dairy)	Lindgren	0.733
Sugar (brown)	CSR	3.663
Pepper on Salt	Lindgren	0.190
Ginger on Salt	Lindgren	0.366
Vinegar (white)	-	9.230
Soy Sauce (Japanese)	GroMarket	10.695
Worcestershire Sauce	-	1.846
Sodium Nitrite	Lindgren	0.021
85 CL Beef Trims	IMTP (wholesale)	73.256
TOTAL		100.000

Methodology:

·1· Separately weigh all meat and nonmeat ingredients;
·2· Mince meat through 5 mm plate (once);
·3· Transfer to Stephan bowl cutter;
·4· Add dry ingredients to Stephan bowl cutter;
·5· Cut at low speed;
·6· Add liquid ingredients to Stephan bowl cutter;
·7· Cut at high speed until homogenous and no free liquid is present;
·8· Transfer to sausage filler with modified nozzle;

2.5 Produce a batch run of reformulated stickette style beef jerky (cont'd)

Methodology: (cont'd)

·9· Fill into Devro 13A16 Meat Snacks Casings;
·10· Tie ends and arrange on mesh trays;
·11· Dry at 55 °C* to a water activity of 0.70 - 0.80;
·12· Transfer to plastic bags and allow to cool and equilibrate in chiller;
·13· Cut to desired lengths (45 mm);
·14· Pack in 100 g packs under Nitrogen flushing in barrier pouches (Trigon - tufflex 150 x 200 mm).

* Dehumidified air heat pump drier, maximum air velocity.

Report:

The finished product water activity was 0.63 and was achieved with 14 hours drying at 55 °C. Modification to the sampling plans and pretreatment of the samples prior to assay contributed to real time processing water activity and ex-production water activity differing by just 0.02.

The major difference between this product and Japanese stickette was a higher extension rate in the former, i.e. less meat was used. Again the continued cutting of the meat emulsion within the bowl cutter was found to be crucial as free liquid filled into casings resulted in a heavily wrinkled product of uneven thickness.

The previously detected sour notes within the Tropicali flavour profile were not evident although the very dry texture detracted from this product quality gain.

The salt content was unexpectedly high and is attributed to the great loss of liquid due to the high nonmeat extension.

The bacterial load was similar to the Japanese stickette and reflects the high degree of handling required during the filling (hand linking) and loading onto mesh trays. Careful consideration as to commercial production techniques should alleviate this excessive handling and thereby contribute to a reduction in overall bacterial load.

Despite excessive drying the fat level in the finished product was considered reasonable if a little on the low side. However, that fat particles were larger than when a double pass through the 5 mm plate was used in the Japanese stickette with fat plugs appearing in the casings. It is likely that a 3 mm mincing plate should be used in commercial operation.

Conclusions:

85 CL beef is an acceptable raw material for this product when reduced less than 5 mm;

Modification to the recipe and drying time (< 14 hours at 55 °C) with respect to the extension of the meat is required to better align the product with the markets;

2.5 Produce a batch run of reformulated stickette style beef jerky (cont'd)

Conclusions: (cont'd)

Sampling plans and analysis pretreatments utilised were successful as a guide for predicting the true end point of drying;

Consideration be given to the introduction of mechanical linking or other automation within the commercial production system.

2.6 Produce a batch run of Taiwanese style powdered beef

Background:

The methodology and ingredients within the powder were derived from discussions with Mr F.Wong (29/9/94) during which he described the ingredients used within Taiwanese style beef powder and included starch, sugar, yeast extract, soya sauce, salt, and chinese 5 spice. Mr Wong confirmed that the product was spray dried and was used primarily as an aromatic flavouring. The suggested finished salt level was 6-10 %.

Aim:

Produce a batch run of Taiwanese style powdered beef.

Recipe:

Table 6. Recipe for Taiwanese style powdered beef.

Ingredient	*Supplier*	*Percentage (w/w)*
Salt (dairy)	Lindgren	0.326
Sugar (brown)	CSR	0.651
Dextrose	-	0.977
95 CL Beef	IMTP (wholesale)	32.573
Soy Sauce (Chinese)	-	0.355
Chinese 5 Spice	-	0.010
Chilled Water	-	65.108
TOTAL		100.000

Methodology:

·1· Mince chilled beef through 8 mm plate;
·2· Separately weigh all nonmeat ingredients;
·3· Weigh meat;
·4· Add beef to bowl cutter;
·5· Add dry ingredients to Stephan bowl cutter;
·6· Cut for < 1 minute;
·7· Add soy sauce and 1/2 chilled water;
·8· Cut for < 2 minutes;
·9· Dilute with remaining chilled water;
·10· Cut for 5 minutes;
·11· Pass through sausage emulsifier (2mm plate);
·12· Pass through brush finisher (2mm sieve);
·13· Transfer to heating vessel;

2.6 Produce a batch run of Taiwanese style powdered beef (cont'd)

Methodology: (cont'd)

·14· Heat to 70-80 °C;
·15· Pass through brush finisher (2mm sieve);
·16· Transfer to holding tank - inlet product temperature recorded 72-75°C;
·17· Spray dry at 200 °C;
·18· Transfer to intermediate holding bag;
·19· Transfer into final packaging;
·20· Pack in 100 g units under minimal vacuum in barrier pouches (Trigon - Tufflex 150 x 200 mm).

Report:

Product was removed by the brush finisher prior to heating (step 14). This is believed to be mainly collagenous in nature and is considered recoverable with the elimination of steps 11 and 12 and the inclusion of the emulsification step after the heating step 14.

A fawn-light tan coloured material was recovered that was has a dull background aroma of chinese five spice. The finished product salt content was found to be significantly lower than the range suggested by Mr Wong and the high protein level suggests that further extension may be desirable.

At the time of production no material had been submitted from the Taiwanese market. However, Mr G.Bloxham was able to forward a sample (rec'd 24/11/94). There is a great deal of visual and aromatic difference between the trial product and the market sample. Major product redevelopment is expected to bring the samples closer together with chemical analysis and interpretation of the Taiwanese beef powder required before further development could be planned.

Conclusion:

Taiwanese beef powder is significantly different from that produced within Stage 2.6.

2.7 Produce a batch run of Japanese style reformed shredded beef jerky strip

Background:

Several samples of beef jerky were previously provided and assayed (Stage 2 - Supplementary Report - Nov.'94) - one of these was a reformed and shredded jerky product. Mr Kirk requested that a similar product be developed.

Aim:

Produce a batch run of Japanese style reformed shredded beef jerky strip.

Recipe:

Table 7. Recipe for Japanese style reformed shredded beef jerky strip.

Ingredient	*Supplier*	*Percentage (w/w)*
Salt (dairy)	Lindgren	1.08
Sugar (brown)	CSR	3.00
Pepper on Salt	Lindgren	0.20
Vinegar (white)	-	2.50
Soy Sauce (Japanese)	GroMarket	7.00
Sodium Nitrite	Lindgren	0.20
Scanpro T95 $<100\ \mu m$ Dehydrated Pork Meat*	Lindgren	0.60
85 CL Beef	IMTP (wholesale)	85.70
TOTAL		100.00

* This should be included on the ingredient listing as *pork*.

Methodology:

·1· Mince meat through 5 mm plate (twice);
·2· Separately weigh all meat and nonmeat ingredients;
·3· Combine all dry nonmeat ingredients;
·4· Add meat to mixer blender;
·5· Begin slow blending;
·6· Slowly add dry ingredients - maintain slow blending;
·7· Slowly add wet ingredients - maintain slow blending;
·8· Blend till homogenous;
·9· Transfer to moulds (200 mm x 390 mm x 5 mm);

2.7 Produce a batch run of Japanese style reformed shredded beef jerky strip (cont'd)

Methodology: (cont'd)

·10· Form cakes of meat emulsion;
·11· Transfer cakes to lubricated mesh trays;
·12· Dry at 55 °C* to a water activity of 0.70 - 0.80;
·13· Transfer to plastic bags and allow to cool and equilibrate in chiller;
·14· Cut to desired width (2mm);
·15· Pack in 100 g packs under Nitrogen flushing in barrier pouches (trigon - Tufflex 150 x 200 mm).

* Dehumidified air heat pump drier, maximum air velocity.

Report:

This product was dried to a water activity of 0.73 in 10 hours at 55 °C and compares favourably with the Japanese market version (Stage 2 - Supplementary Report - Nov.'94).

Scanpro T95 was used to allow binding to occur at relatively low temperatures (55 °C). This product was not difficult to use in the manner described above although a change in viscosity and stickiness was noted 1 hour after blending with the meat, i.e. the binding was already occurring despite temperatures of the meat being kept below 15 °C. The bound product did not separate when sliced after drying.

The double mincing step was necessary to achieve an acceptably sized fat particle. It is envisaged that a 3 mm plate would be used commercially.

85 CL meat was used to minimise costs and is significantly different to that apparently utilised in the Japanese market. The product is considered to be slightly fatty, though reminiscent of shredded traditional salami.

The salt content was higher than that found in the Japanese markets (Stage 2 - Supplementary Report - Nov.'94), yet it was similar to that found in the Australian market (Stage 1 Report - Sep.'94).

The relatively low bacterial load is attributed to the few processing steps involved.

This product retained a high yield which is attributed in part due to the high level of fat inclusion and to the binding ability of Scanpro T 95.

The low level of sodium nitrite was expected and falls within typical industry levels for cured manufactured meat products.

2.7 Produce a batch run of Japanese style reformed shredded beef jerky strip (cont'd)

Conclusions:

The recipe and methodology listed does enable the production of a reformed and shredded jerky product;

The choice of meat raw material requires to be reviewed against market expectations;

The current level of sodium nitrite be maintained in future recipes;

Scanpro T95 is an effective low temperature binder of meat;

The drying time required is 10 hours at 55 °C.

2.8 Produce a batch run of Tropical beef jerky chip

Background:

Following an earlier production trial (Stage 1 Report - Sep.'94), Mr Kirk confirmed that the trial was to be repeated with the following exception: the meat was to be cut at 5 mm instead of 3 mm prior to drying.

Aim:

Produce a batch run of Tropical beef jerky chip.

Recipe:

Table 8. Recipe for Tropical Beef Jerky Chip Injectant.

Ingredient	*Supplier*	*Percentage (w/w)*
Salt (dairy)	Lindgren	0.227
Sugar (brown)	CSR	14.170
Pepper on Salt	Lindgren	0.589
Ginger on Salt	Lindgren	1.134
Garlic on Salt	Lindgren	1.179
Pineapple Juice (unsweetened)	Golden Circle	41.308
Soy Sauce (Japanese)	GroMarket	41.376
Sodium Nitrite	Lindgren	0.017
TOTAL		100.000

Methodology:

·1· Prepare marinade;
·2· Add marinade to injector;
·3· Set injector to attain 15 % injection (approx. 1.5 bar pressure);
·4· Pass meat through injector twice;
·5· Transfer to massager;
·6· Massage for approx. 23 hours under vacuum with 10 minutes on and 10 minutes rest;
·7· Transfer to tempering room (-5 +/- 2°C);
·8· Temper to -5°C internal temperature (12-18 hours);
·9· Slice at 5 +/- 1 mm;
·10· Dry at 55°C to a water activity below 0.75;
·11· Cool at ambient temperature;
·12· Cut into 1 inch (25.4 mm) x 1 inch (25.4 mm) strips;

2.8 Produce a batch run of Tropical beef jerky chip (cont'd)

Methodology: (cont'd)

·13· Pack in 100 g under Nitrogen in barrier pouches (Trigon - Tufflex 150 x 200 mm).

Dehumidified air heat pump drier, maximum air velocity.

Report:

The bacterial load was relatively high and reflects the high degree of handling required during the slicing, loading and unloading of mesh trays. Careful consideration as to commercial production techniques should alleviate this excessive handling and thereby contribute to a reduction in overall bacterial load.

The water activity of 0.69 was achieved in a drying time of 5.75 hours at 55 °C. the water activity and the moisture level compare favourably with the Japanese market.

The salt content was marginally higher than that found in jerky samples from the Japanese market (Stage 2 - Supplementary Report - Nov.'94) although natural form jerky were not submitted from this market.

The fat level was much lower than that found in jerky samples from the Japanese market (Stage 2 - Supplementary Report - Nov.'94) and reflects the nature of the product, i.e. natural form muscle jerky as opposed to reformed jerky.

Conclusions:

It is feasible to produce beef jerky strips using injection and massage technology;

The drying time for this product is approximately 6 hours;

The salt level requires minor adjustment in future product development trials.

2.9 Produce a batch run of Taiwanese style beef jerky cubes

Background: Refer to Stage 2.2 and 2.4.

Aim:

Produce a batch run of Taiwanese style beef jerky cubes.

Recipe: Refer to table 4 - recipe for Taiwanese Style (Fruity) Marinade.

Methodology:

·1· Ensure all ingredients are chilled (2-4 °C);
·2· Cut meat to approximately 18 cm x 18 cm x 24 cm;
·3· Weigh meat;
·4· Separately weigh and combine all marinate ingredients;
·5· Add meat to tumbler massager;
·6· Add desired amount of marinate (30 %);
·7· Massage under vacuum for 10 minutes on + 10 minutes rest for 18 hours (approximately 2000 revolutions);
·8· Transfer meat to steam jacketed water bath @ 90-95 °C;
·9· Cook to an internal temperature of 75-85 °C (3 hrs);
·10· Transfer meat to refrigerator and allow to cool to 0-4 °C;
·11· Slice at 5 mm +/- 2 mm;
·12· Place on mesh tray;
·13· Dry at 55 °C to a water activity of 0.60 - 0.70;
·14· Transfer to plastic bags and allow to cool and equilibrate in chiller;
·15· Pack in 100 g packs under Nitrogen flushing in barrier pouches (Trigon - Tufflex 150 x 200 mm).
• Dehumidified air heat pump drier, maximum air velocity.

Report:

Both the Taiwanese style strip and cube jerky were processed at the same time and were combined during equilibration. The total drying time was 11.75 hours and at the time the cube was removed it had a water activity of 0.88. There were signs of case hardening and some blackening of product detected. It is suggested that a drying time in excess of 20 hours would be required to achieve a water activity between 0.60 and 0.70 for this strip product. It is further suggested that the drying temperature be reduced to minimise the case hardening phenomena.

After equilibration, in contact with the Taiwanese style jerky strips, it was found that the water activity of the cube had not altered.

The results of the chemical analysis were predictable given that the product had not received adequate drying.

The method of cooking and slicing was readily incorporated and did contribute to significantly lower bacterial loads within the products as compared to other products made during these Stage 2 investigations.

2.9 Produce a batch run of Taiwanese style beef jerky cubes

Report: (cont'd)

The product did have gristle present although some trimming to bring it back to 90 Cl may be required. The fat present had coated the majority of the meat surfaces which would have retarded the rate of drying and there were also some cubes of fat produced.

Conclusion:

Case hardening was encountered with 12 hours drying at 55 °C;

A drying time in excess of 12 hours is required to reduce the water activity to between 0.60 and 0.70;

The drying process be modified before continuing with product development;

90 Cl trim or better should be used in future trials.

Table 9. Chemical analysis of dried beef products.

Product	Moisture (%)	Fat (%)	Salt (%)	pH	Water Activity	Protein	Total Sugars (%)	Sodium Nitrite (mg/kg)
Japanese style beef jerky stickette	28.8	20.5	4.9	5.6	0.79	-	-	24
Taiwanese style beef jerky strips	19.7	13.6	1.8	6.1	0.79	-	-	-
Outback Tucker beef jerky stickette	21.5	19.5	7.0	5.1	0.63	-	-	-
Taiwanese style powdered beef	6.2	3.8	2.3	5.8	-	71.7	14.5	-
Japanese style reformed shredded beef jerky strips	21.9	28.3	5.0	5.7	0.73	-	-	10
Tropical beef jerky chip	23.1	6.5	4.7	5.5	0.69	-	-	-
Taiwanese style beef jerky cubes	25.7	19.5	1.6	6.0	0.88	-	-	-

Table 10. Microbial analysis of dried beef products.

Product	Standard Plate Count (per g)
Japanese style beef jerky stickette	13 000
Taiwanese style beef jerky strips	300
Outback Tucker beef jerky stickette	44 000
Taiwanese style powdered beef	230 000
Japanese style reformed shredded beef jerky strips	10 000
Tropical beef jerky chip	160 000
Taiwanese style beef jerky cubes	400

Table 11. Yield on meat input for 7 different dried beef products.

Product	Meat Input (Kg)	Final Output (Kg)	Yield on Meat Input (%)
Beef Powder	10.7	1.8	16.8
Japanese (Eastern) Stickette	10.0	4.9	49.0
Taiwanese (Fruity) Jerky Strip	8.1	2.2	27.2
Taiwanese (Fruity) Jerky Cube	11.9	3.6	30.3
Reformed Shredded (Eastern) Jerky	8.6	3.8	44.2
Tropicali Jerky Strip	8.8	3.3	37.5
Outback Tucker Stickette	10.1	4.0	39.6

SUPPLEMENTARY REPORT ON THE ANALYSIS OF BEEF JERKY PRODUCTS OBTAINED FROM THE JAPANESE MARKET.

STAGE 2.
SUPPLEMENT

Commissioned by: Horizon Holdings (NQ) Pty Ltd (ACN 058 486 712)
PO Box 2238
TOWNSVILLE QLD 4810

Reviewed by: C.J.J.Sanders

IFIQ
Department of Primary Industries
November.1994

Background:

Mr R Kirk submitted samples (26.8.94) of beef jerky stickette, shredded reformed beef jerky, salami style beef jerky and flattened encased beef jerky sourced from the Japanese market.

These samples were to be supplemented with fresher samples and translations of the packaging information. The samples were then to be assayed to determine the parameters for further product development requests that formed the basis of the Stage 2 dried beef product and process development project.

The fresher samples and the packaging information translations did not eventuate and Mr Kirk approved the chemical analysis to be conducted on the limited sample originally submitted.

Due to the age and handling history of the submitted samples, microbial analyses were nt conducted.

Aims:

1 Analyse and interpret samples of Japanese dried beef stickette jerky;

2 Analyse and interpret samples of Japanese dried reformed and shredded beef jerky;

3 Analyse and interpret samples of Japanese dried salami style beef jerky;

4 Analyse and interpret samples of Japanese dried encased and flattened beef jerky.

Analyses:

Table 1. Salient chemical parameters of various finished dried beef jerky products from Japan.

Beef Jerky Product	*Moisture (%)*	*Fat (%)*	*Salt (%)*	*Water Activity*
Stickette*	17.0	36.7	3.2	0.71
Reformed & Shredded	25.2	5.7	3.9	0.75
Salami Style*	27.3	32.4	4.4	0.80
Encased & Flattened	20.9	36.1	2.9	0.78

* All sample consumed in chemical analysis

Table 2. Salient physical and cost parameters of various finished dried beef jerky products from Japan.

Beef Jerky Product	*Appearance*	*Dimensions*	*Oxygen Absorber Used (Y/N)*	*Pack Weight (g)*	*Cost (¥) (AUG 94)*
Stickette	Mildly wrinkled cylindrical nonencased cured minced meat with fat size varying between 3 & 10 mm	45 mm length 10 mm diameter	Y	82	298
Reformed & Shredded	Irregular surfaced strips of mottled cured reformed minced meat	4 mm height 3 mm width 130 mm length	Y	23	198
Salami Style	Mildly wrinkled cylindrical nonencased cured minced meat with fat size varying between 3 & 6 mm	2-3 mm height 33-35 mm diameter	Y	12	-
Encased & Flattened	Flattened encased cured minced meat with fat size varying between 2 & 3 mm	5 mm height 17 mm width 160 mm length	Y	25	100

Report:

All the products could be classified as dried meat products under Australian legislation. Unexpectedly high water activities were found in the salami style and encased and flattened samples suggesting either a stratification within the beef jerky market or the adaption of existing products to the market incorporating a deliberate strategy of maximising yield.

All examples of beef jerky from the Japanese market were minced prior to drying. This reforming is significantly different from samples previously investigated from the Australian and Hong Kong markets (Stage 1. Report - Sep.94).

The high fat content for the stickette, salami style and encased and flattened jerkies suggest the use of 85 CL beef as a raw material. This is significantly different to both the Australian and Hong Kong markets as previously reported. The raw material for the reformed and shredded jerky appears to have been 95 CL or denuded beef which is in line with both the Australian and the Hong Kong markets.

The finished product salt level fluctuated between 3 and 4.5 % and is lower than the previously reported Australian product levels and in line with Hong Kong product (Stage 1 - Report Sep.'94).

The addition of oxygen absorbers in all packs may highlight a need for extended shelf protection or a market expectation for these products.

Both the salami style and the stickette style beef jerky were presented on moulded trays suggesting a gift pack market. Each stickette was individually wrapped with clear plastic presumably for hygienic handling after pack opening.

The absence of casing around the stickette suggests either one was used and then removed or a relatively highly automated dedicated production technology was used.

The reformed shredded product appears to have been formed in sheets, dried and then continuously sliced longitudinally followed by a regular crosscut to achieve the desired length. The appearance of white deposits through out the product appears not to be fat and is surmised to be either a starch or maltodextrin extender. This then implies a processing temperature in excess of 70 °C.

The date of production appeared to be stamped on the packs with no discernible *use by date*.

Conclusions:

The apparently desired water activity for the Japanese beef jerky market ranges between 0.70 and 0.80.

The apparently desired fat level of the raw beef for the Japanese beef jerky market ranges between 85 and 95 CL.

The apparently desired salt level for the Japanese beef jerky market ranges between 3 and 4.5 % in the finished product.

All reviewed Japanese beef jerky product have oxygen absorbers added to the packaging.