final report

Project code: V.RMH.0097

Prepared by: Patrick Youil, Francois Tabbakh
Retail Ready Operations Australia Pty Ltd

Date published: February 2020

PUBLISHED BY
Meat and Livestock Australia Limited
PO Box 1961
NORTH SYDNEY NSW 2059

Preliminary Review of Liquid Lock Red Meat Trays as an alternate to soaker pads

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

The purpose of this project is to complete a preliminary review of the soaker pads used for red meat and to explore the potential benefits of incorporating an array of small cells into the bottom of an in-line thermoformed tray to capture and retain exudate from the packaged product. The retention of the exudate in the cells would be based on the surface tension characteristics of the liquid.

If successful, the development would enable the removal of the traditional soaker pad from red meat trays leading to significant manufacturing productivity gains through packaging material and labour savings. The development would also provide environmental benefits with a reduced packaging footprint, less waste to landfill, and enable the claim of a fully recyclable tray.

A significant amount of research work and learnings have been included in this milestone report. Despite not being successfully at producing robust trays at speed, Coles is committed to follow this course of action up. The challenge to date has been the use of recyclable base film which has restrictive properties. The next phase(s) of the project will focus on Coles RROA working with suppliers to further advance this research.

Therefore, the project next steps will involve:

- Trial of the same inserts with a different film with better heat forming properties or higher temperature tolerance
- If successful trays can be formed, move to production trial including assessment of impact to product quality attributes
- If successful, complete cost benefit analysis of no soaker pad option to introduce sustainable packaging

Executive summary

Incorporating an array of small cells at the bottom of meat trays to capture product exudate has the potential of replacing soaker pads. This would reduce the packaging footprint, eliminate a non-recyclable element of the meat tray, and reduce labour requirements.

So far in Australia, all available trays featuring liquid locking type arrays are produced on off line formers. One of the main challenges in this innovation project is the development of a mould insert and the fine tuning of thermoformer machine parameter settings for inline tray production.

Following inconclusive trials with prototype mould inserts, RROA has engaged a food packaging solutions provider to join in to the development of a mould design adapted to the Multivac inline thermoformer operation (See Photo A1). These new mould insert prototypes have been successfully trialled in New Zealand on similar Multivac thermoformers using the same film used at RROA, these are now scheduled for trials at RROA.

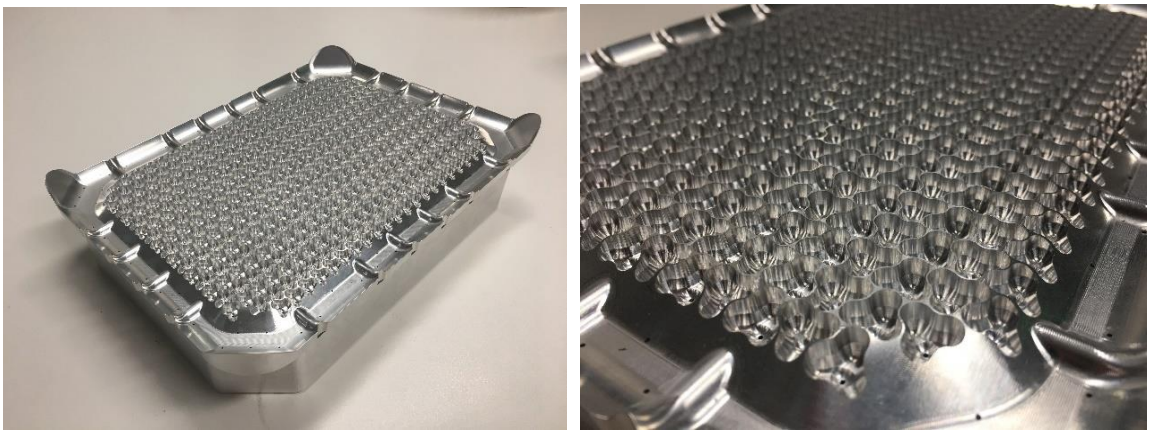

Photo A1: Inserts for the trial of the red meat tray soaker pad removal.

The objective of the first phase of trials will be the production of trays with liquid locking array on the Multivac thermoformers at full speed. Key elements in the success of these trials include the insert design and its compatibility with the possible machine operating parameters. The film properties also need to be considered as these also impose their own requirements on operating parameters. The whole development process may involve a few iterations to achieve optimal forming quality and productivity.

Once trays have successfully been produced, a second phase of trials will focus on the effects of the new tray design on product quality attributes and productivity. Potential productivity benefit exceeds $1M / year.

Table of contents

1 Background

Across Australia and New Zealand's meat sector, more than 750 million soiled absorbent pads end up in land fill each year. The red meat industry would benefit by further reducing the manufacturing cost of packaged tray meat. RROA produces millions of red meat trays which utilise soaker pads to absorb any excess exudate. Finding a solution which will eliminate soaker pads could result in potential savings exceeding $0.4M/yr.

Furthermore such a solution would also reduce the labour intensive and repetitive process of inserting soaker pads into each tray and save additional labour costs estimated at close to $0.6M/yr.

Plastic free and “bring your own containers” is also a trend that MLA’s 2Morrows Food Program have identified as consumers (and brand owners) desire for more sustainable options (see: https://my.morrisons.com/blog/community/bring-your-own-container/). This project aims to bring to life this opportunity space with Coles RROA to present a brief overview of the current soaker pad imposts and a concept being explored with thermoform webbing. Lessons learned can be applied to the wider Australian red meat industry and packaging sector accordingly.

Currently soaker pads are used to absorb exudate from meat that collects in the bottom of a packaging tray during the shelf life of the product. The soaker pads are non-recyclable and go to landfill via the domestic rubbish collection system after the consumer has opened the tray. The material they are made from is non-renewable. During the red meat manufacturing process, soaker pads are manually placed in the bottom of the thermoformed trays as they exit the tray thermoforming area and prior to the meat being loaded into the tray. The application requires a full time person per packaging line.

Photo 1: Current Soaker pad in meat tray

Photo 2: Example of Liquid Lock in Tray

Coles RROA are a leading case ready packing site and have a desire to showcase to wider industry options to reduce landfill waste and use packaging materials for red meat that are made from recyclable / renewable materials only. The project will also provide commentary on productivity gains in manufacturing to ensure lower cost products can be provided to consumers with alternates to current soaker pads. The initiative will also address associated OH&S issues which will be improved by eliminating a repetitive manual task.

Currently soaker pads are used across the fresh meat, poultry and fish industry, varying in size to suit the product type and weight of product in the tray. They have been in use since the move to packaged

meat in supermarket display shelves. There has been research into more sustainable types of soaker pads where the material is recyclable or made from renewable materials however these have yet to be commercialised. The “Liquid Lock” type technology has been previously applied in Europe to pre-formed trays to capture the exudate and replace the need for the traditional soaker pad. The “Liquid Lock” technology is based on the surface tension of the liquid exudate enabling it to be retained in within a small cell. The cell(s) will continue to collect exudate throughout the shelf life of the product but not release it back into the tray even when it is turned upside down.

In New Zealand, Foodstuff (Coles) has trialled and now converted 100% of their “pre-formed” trays for meat over to the “Liquid Lock” tray. Consumer feedback over the trialling period was positive based on the benefits to the environment. Trialling and market research are continuing the Liquid Lock technology in New Zealand. Multivac (the manufacturer of in-line Thermoformers Coles RROA have adopted) has been engaged in helping to develop an “in line thermoforming” version of the Liquid Lock enhanced trays, which is much more complex at the higher inline machine speeds of up to 90 packs per minute and has not previously been successfully achieved.

It should be noted that there have been no previous projects or attempts within Coles and/or RROA to address the soaker pad replacement issue. This appears to be representative of the wider retail landscape in Australia and therefore, the outcomes of this report can provide new knowledge for wider Australian red meat industry.

2 Project objectives

The overall aim is to review several “no soaker pad tray designs” and preliminary evaluations of liquid locking system in a commercial mode at Coles RROA and in the context of desire for more sustainable packaging and control of drip purge in red meat.

Specific Objectives of the project are:

- Provide an overview of current applications of red meat soaker pads and alternate solutions – including introducing the pros and cons for a thermoformed Liquid Lock concept produced on-line at Coles RROA
- Define and deliver preliminary concepts at Coles RROA, make modifications to machine moulds and equipment, and review the resultant product quality, yields, costs, and shelf life from its end to end supply chain application.
- Review the overall value proposition (such as labour, packaging and manufacturing cost, customer feedback on appearance and sustainability etc.) associated with the elimination of soaker pad addition.
- Include photos and relevant process and material design summaries for wider industry to demonstrate concept(s) and key findings, including thermoform solutions, costings and customer feedback compared to current offer and alternates to pre-formed liquid lock trays and addition of soaker pads in trays.
- The final report is to include estimated impacts on labour and machinery costs and reduced landfill, modelled on future Coles RROA activities and usage of Australian red meat and recommendations on strategies on how to measure what, if any, future impacts on growing demand of Australian red meat or Productivity efficiencies would be if commercialised (key MLA measurement and evaluation metrics for MLA R&D investments).
- Recommendations for next steps scale up and R&D plan (where required, commercial in confidence business case calculations may be sanitised for the final MLA report) which may

include a potential phase 2 project proposal (beyond this project) from Coles RROA to MLA for consideration.

In a preliminary phase, Coles RROA trialled prototype mould inserts made by Multivac in Germany. Despite many attempts with various thermoformer parameter configurations, the trays produced lacked definition or had overheated film defects. Because it could not be determined whether the mould insert design, operation know how, or formability limitations of the film were at cause, this trial was deemed inconclusive.

2.1 New Insert Design

Liquid lock trays are widely used in New Zealand, trays are produced offline using thermoforming tray making equipment and sent to packaging facilities and stores. To capitalise on this experience and know how, Coles RROA have partnered with a company which supplies pre-formed trays to some parts of the NZ market.

A prototype mould insert was developed and successful in producing trays on a Multivac trayformer using the same film used at Coles RROA.

Photo 1: Liquid lock tray produced with offline tray former

The tray's design features a triangular pattern with sharp edges which maximises the surface area to volume ratio which enhances the effect of surface tension and the tray's liquid retaining capability.

The intricate array requires suction to be applied to the base of every small cavity. Suction pressure distribution across the base of the mould insert has been an important aspect of this insert design.

2.2 Production Process

The Multivac thermoformers installed at Coles RROA operate on the vacuum thermoforming principles where a sheet of thermoplastic is softened with heat before being drawn into a mould cavity by suction. When the plastic comes into the contact with the mould surface it cools down and hardens.

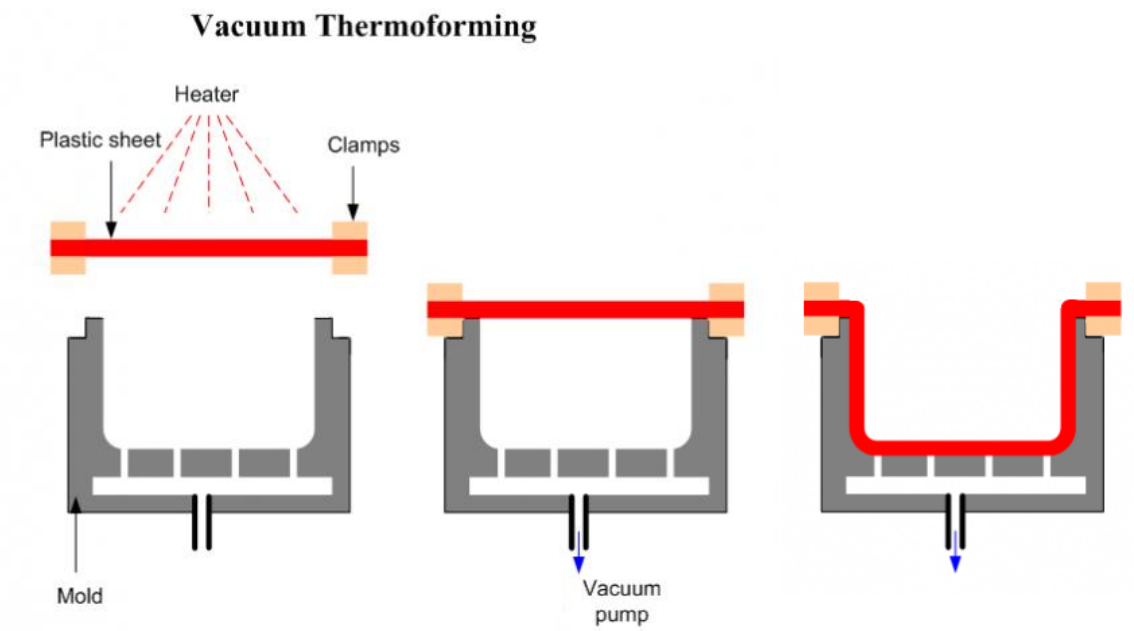

Photo 2: Vacuum Thermoforming Diagram

On October 14th and 15th, a set of four 11x9 new mould prototype inserts were trialled on the in-line thermoformers at Coles RROA. The insert design engineer and a Multivac technician were on site to support the trial. The inserts were trialled on two production lines to experiment with two film thicknesses used at Coles RROA.

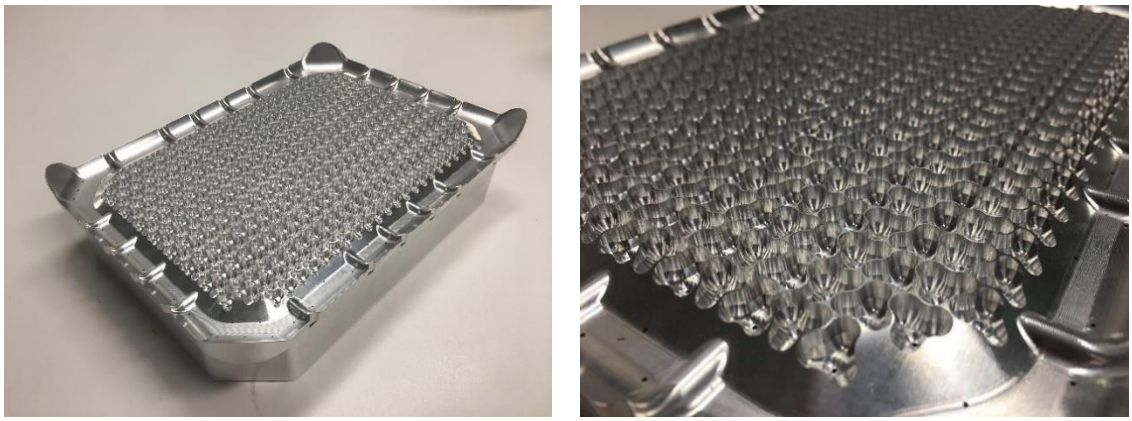

Photo 3: 11x9 mould insert designed for trial in Coles RROA Multivac tray former

The trials were performed on Multivac model 535 Thermoforming packaging machines on lines 1 and 24. These machines are equipped with plug assisted forming, automatic pack depth adjustment, and film pre-heat plates. The following operating parameters were adjusted during the trial:

- Temperature of the pre-heat plates
- Use of top, bottom, or combination of heat plates
- Residence time of the film over the heat plates

The approach during the trial consisted of making incremental adjustments to the heat plate temperature and time settings aimed at achieving satisfactory forming definition without quality defects.

3 Results & discussion

3.1 Tray forming trials

Following inconclusive trials with Multivac prototype mould inserts (Milestone 1), RROA has engaged a food packaging solutions provider to develop a mould design adapted to the Multivac inline thermoformer operation (See Photo 3). These new mould insert prototypes have been successfully trialled in New Zealand on similar Multivac thermoformers using the same film used at RROA. These modified moulds were trialled at RROA.

At the standard machine settings used for regular flat trays, the produced trays lacked definition. The temperature was increased along with heating time in an attempt to improve forming. Though this resulted in better depth and definition of imprint, results were uneven and the new forming conditions created trays with defects attributed to overheating such as warping, opacity, blistering, and inconsistent definition.

Photo 4: Trays formed during the trial – **Lacking definition**

Photo 5: Trays formed during the trial – **Over heated film**

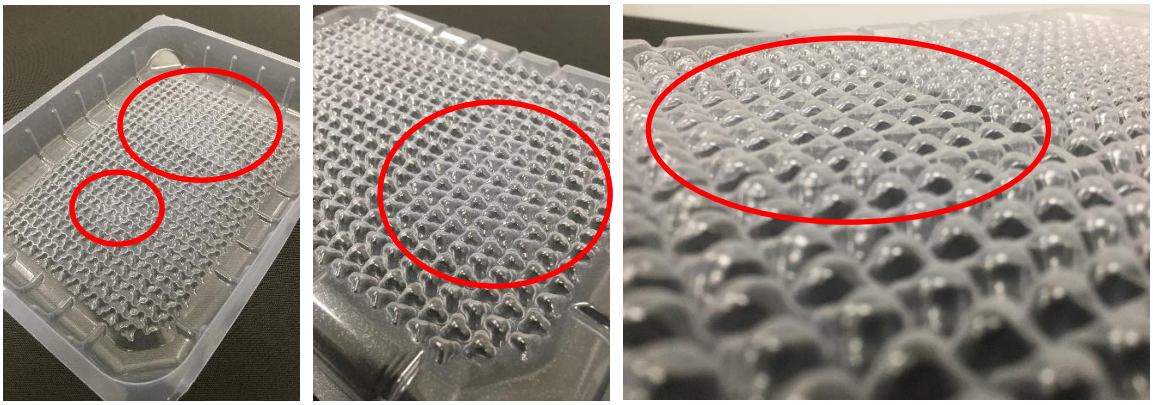

Photo 6: Trays formed during the trial – **Inconsistent forming definition**

The same trends were observed on both machines and film thicknesses. Based on these results the general consensus is that the formability required for the liquid lock array on this equipment is beyond the film's capability; the heat required to achieve forming definition causes the film to blister and deteriorate. Further trials with a different film material may be required to validate this hypothesis. It is worth noting that liquid retaining properties were achieved in the trays which had better definition.

The difference with this trial and what was done in New Zealand using the same film (covered in section 3.1) is in the forming sequence used by the thermoforming machines. The Multivac tray former used in the New Zealand trial heats the film in its forming position above the mould. Because the 535 models used at Coles RROA feature plug assisted forming, one section of the film is heated while the section ahead is being formed. This allows to reduce the cycle time as the film is pre-heated when it arrives at the forming stage. This however results in a few seconds delay between heating and forming of the film, as the forming temperature is in the range of 130°C and room ambient temperature around 4°C, it is likely the heated film temperature drops a few degrees between the end of heating and the forming step. The higher temperature required to make up for this heat loss may be causing the overheating defects on the film.

Considering the film's maximum temperature limit and the need for highly formable film, uniform heating of the film will be key to consistent forming across the base of the tray. Any hot or cold spots on the heat plates may result in inconsistent forming or defects.

3.2 New steps

3.2.1 In line tray forming at high speed

In the next phases of tray forming development, care will need to be given to the requirements and limitations encountered in regular production. For example, the effects of start/stop operation or pauses on the tray forming machine will cause the film to reside over the heat plates for a longer period and potentially result in defects. Any new constraint or operational limitation imposed by a new process will need to be clearly identified to ensure quality and productivity levels are maintained. The goal should be to develop a process which relies on operating parameters situated well within the standard range of machine and material capabilities.

3.2.2 Further trials & broader scope

Despite unsuccessful trials to date, interest in pursuing the project objectives remains, production of liquid lock trays on in-line thermoformers would provide cost benefits, improve sustainability, and promote sales by better recyclability.

The next phases of development will need to consider changes to the way heat is applied to the film in the thermoformers as well as base film formulation. Base films are often multilayered extrusions, the different layers provide barrier properties and ensure sealing adhesion with top film. The overall thickness and nature of each layer also affects the film's structural integrity and formability. Optimisation of any attribute by changes to the formulation inevitably results in changes to other properties as well. In addition to the film's MAP preservation attributes (oxygen barrier), the selection of the bottom and top film needs to be reviewed based on formability, compatibility with top film, and recyclability.

Successful implementation of any change to the in-line tray making process needs to consider all parameters as these are all linked with direct impact on operational methods and tray quality. A holistic approach will be required in developing the next generation of fully recyclable trays.

Coles RROA intends on proceeding with further trials using potential new base and top film materials. All product (tray) attributes as well as the operability window and ease of production will be evaluated.

3.2.3 Alternatives

Alternatives to the complete elimination of the soaker pads were also considered.

Automated pad dispensing systems from specialised packaging equipment vendors were evaluated. Preliminary concept and budget evaluations indicated this would be complex equipment requiring fine adjustments at each changeover and requires significant capital investment to fully develop and acquire. This option was eliminated due to the low financial benefit and the fact that this alternative would not be aligned with sustainability objectives.

Compostable absorbent pads could improve overall recyclability, however these pads typically have lower liquid retention capacity and considerably higher costs. From a consumer perspective the pads would still be discarded to landfill, even if compostable. The risks of reduced performance, cost increase, and negative impact on the consumer experience make this option less attractive.

3.2.4 In-store butcher trials

Coles have recently completed recent market research which has confirmed that MAP red meat packaging formats are preferred as they are perceived as having "fresh" appearance however the format ranked least preferred when considering recyclability. Further, MSA eating profiles have found vacuum skin packaged meat has improved qualities over MAP. The outcomes of this project will be shared with MSA Technical Committee for review.

Liquid lock trays produced offline will be trialled in select Coles in-store butchers, this will help evaluate the effects on the user experience and impact to product attributes.

4 Conclusion and Recommendations

4.1 Conclusion

The purpose of this project is to complete a preliminary review of the soaker pads used for red meat and to explore the potential benefits of incorporating an array of small cells into the bottom of an in-line thermoformed tray to capture and retain exudate from the packaged product. The retention of the exudate in the cells would be based on the surface tension characteristics of the liquid.

If successful, the development would enable the removal of the traditional soaker pad from red meat trays leading to significant manufacturing productivity gains through packaging material and labour savings. The development would also provide environmental benefits with a reduced packaging footprint, less waste to landfill, and enable the claim of a fully recyclable tray.

A significant amount of research work and learnings have been included in this project. Despite not being successfully at producing robust trays at speed, Coles RROA is committed to follow this course of action up. The challenge to date has been the limited formability and heat tolerance of the base film. To progress further, the scope of this project needs to be broadened to include re-evaluation of the selection of base and top film.

Coles RROA to submit final report to MLA on key findings and lessons learned as outlined in project objectives.

Criteria for achievement of this milestone have been defined as:

- Report key findings and lessons learned applied to red meat prototypes
- Summarise recommendations on next phases of development
- Submit final report to MLA

A separate commercial in confidence final report including recommendations for possible phase 2 scale up and further R&D may be submitted to MLA for consideration as a new project. A public version is being finalised to be approved by Coles RROA

4.2 Recommendations

In the next phase(s) of this project, Coles RROA will be working with suppliers to further advance the research on materials with focus on the primary objective being fully recyclable packaging.

Therefore, the project next steps will involve:

- Trial of the same inserts with a different film with better heat forming properties or higher temperature tolerance
- If successful trays can be formed, move to production trial including assessment of impact to product quality attributes
- If successful, complete cost benefit analysis of no soaker pad option to introduce sustainable packaging

In the next phases of development, care will need to be given to the requirements and limitations encountered in regular production. For example, the effects of start/stop operation or pauses on the tray forming machine will cause the film to reside over the heat plates for a longer period and potentially result in defects. Any new unavoidable operating limitation a new process will impose will need to be clearly identified to ensure the same level of quality and productivity is maintained. The goal should be to develop a process which relies on operating parameters situated well within the standard range of machine and material capabilities.

5 Appendix

5.1 Test Plan Criteria

Trial date		Pack size	
Production Line		Depth	
Product		Film Type	
		Film Thickness	

	Current tray with soaker pad (Baseline)	Liquid Lock Tray (Prototype)	Comments
THERMOFORMER			
Line speed			Target is 10 cycles/minute per regular line speed
Film temperature setting			Liquid lock expected to require higher temp
Durability/ maintenance requirements for inserts			No change expected
Mould cooling system			System has available capacity, no impact expected
TRAY			
Film oxygen barrier			
Downstream packaging and handling			Trays are handled by two pick and place robots, trays will need to retain structural integrity
Visual appearance			Colour, opacity
Physical properties			Rigidity, ease of handling
Weight of liquid held (grams)	Soaker pad (wet-dry)	Pack (wet-dry)	
PRODUCT			
Shelf life (days)			Expect 9 to 11 days on regular trays
Package visual appearance			Overall appearance, presence of bood in cells
Product visual appearance			Blood may discolour, imprint on contact side of product