

FOOD AUTHENTICITY TESTING WITH NEXT-GENERATION SEQUENCING

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INTRODUCTION

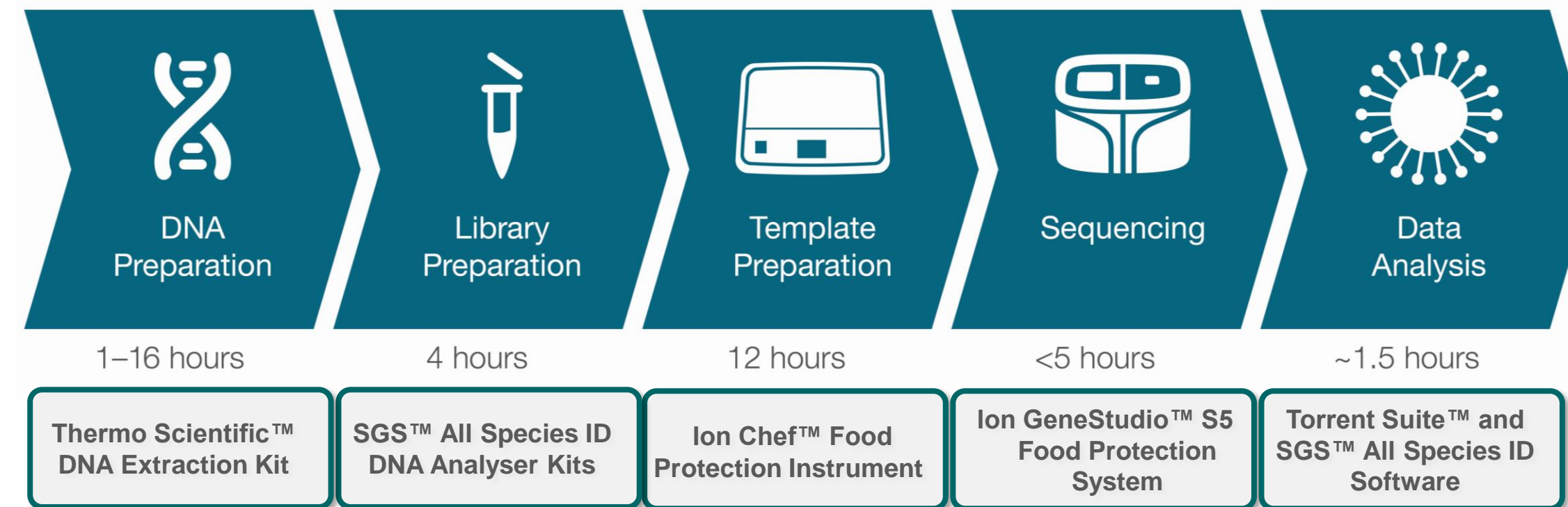
A study was executed in order to identify meat, fish and plant species in food products. The goal was to verify the compatibility of the methods included in the workflow and the identification of species from several different sample types.

- ✓ End-to-end workflow to identify all plant, fish and meat species within a food sample
- ✓ Samples from several food categories (ready-to-eat meals, fresh products, soups, ingredients, canned foods, etc)
- ✓ Comprehensive list of all species detected

MATERIALS AND METHODS

- ✓ **Homogenization** with Precellys® homogenization instrument (Bertin Instruments) to prepare a representative sample for DNA extraction.
- ✓ **GMO Extraction kit** (Thermo Fisher Scientific) with silica based spin-column technology was used to produce high-quality DNA for library preparation.
- ✓ **Libraries for sequencing** were prepared with SGS™ All Species Meat, Fish and Plant Analyser kits (Thermo Fisher Scientific). Unique barcodes (i.e. molecular tags) were added to each sample to enable sequencing and analysis of several samples within the same sequencing run.
- ✓ A fully automated **templating** reaction on the Ion Chef™ Food Protection instrument (Thermo Fisher Scientific) was performed to prepare the sample libraries for sequencing on the Ion Chips.
- ✓ **Sequencing** was performed on the Ion GeneStudio™ S5 Food Protection System (Thermo Fisher Scientific) relying on semi-conductor technology.
- ✓ Sequencing results were mapped against a database of species DNA of meat, fish and plant for **data analysis**. A comprehensive list of all species detected in a sample was generated by the SGS™ All Species ID software (Thermo Fisher Scientific).

WORKFLOW



CONCLUSIONS

90% of the fish species and 95% of the meat species that were declared as an ingredient were detected. Some plant species were not detected with samples where multiple species were listed in the ingredients, but all declared spice species were detected in spice-type samples. Also, since the products tested are real food products there is no information about the concentration of the species labelled in each product and therefore this can impact on the successful detection of species that can be present at a very low level.

The system is able to analyze several sample types and targets (meat, fish and simple plant samples) within a single sequencing run, enabling shorter processing times with lower cost.

FISH PRODUCTS		
Product	Detected species	
Tuna (in water)	Skipjack tuna	✓
Tuna (in oil)	-	✗
Mackerel in tomato sauce	Atlantic mackerel	✓
Canned Sardine	European pilchard	✓
Smoked salmon pizza	Atlantic salmon/Brown trout	✓
Fish rolls (roach, pollock)	Common roach, Pollock	✓
Crispy Cod files	-	✗
Pollock with almond crust	Alaska pollock	✓
Fish and veggie patties	Atlantic salmon/Brown trout, Atlantic cod	✓
Salmon soup	Rainbow trout, Pollock	✓
White fish patties	Lake whitefish, Whitefish Pollock	✓
Lake fish patties	Common bream, Common dace, Ide, Ray-finned fish sp., Common roach, Bream, European perch	✓
Fish fingers	Atlantic cod, Haddock	✓
Smoked sprat	European sprat	✓
Salmon rolls	Atlantic salmon/Brown trout	✓
Rainbow trout strips	Rainbow trout	✓
Pickled herring	Atlantic herring	✓
Salmon loaf	Atlantic salmon/Brown trout, Pollock	✓
Frozen salmon cubes	Pink salmon	✓
Frozen Alaska Pollock	Alaska pollock	✓

MEAT PRODUCTS		
Product	Detected species	
Canned pork & beef	Pork, Beef	✓
Canned ham	Pork	✓
Canned chicken	Chicken	✓
Sautéed reindeer	Reindeer	✓
Sautéed red deer	Red deer	✓
Vegetables and pork	Pork	✓
Ground pork & beef stick with cheese	Pork, Beef	✓
Pork & beef dumplings	Pork, Beef	✓
Smoked and sliced pork, turkey and chicken	Pork, Turkey, Chicken	✓
Beef soup	Beef	✓
Pork liverwurst	Pork	✓
Sliced ham	Pork	✓
Bratwurst (pork, beef)	Pork, Beef	✓
Sausage (Chicken, pork, beef, turkey)	Chicken, Pork, Beef	✗
Ox meat chips	Beef	✓
Kebab meat	Beef	✓
Beef and pork patties	Beef, Pork	✓
Ground beef & pork patties	Beef, Pork	✓
Minced chicken	Chicken	✓
Low fat minced beef with chicken	Chicken, Beef	✓

PLANT PRODUCTS		
Product	Detected species	
Bell pepper spice	Pepper	✓
Potato, onion and meat	Onion	✗
Beef soup (Potato, carrot, parsley, swede, leek, rapeseed)	Wild carrot, Wild leek, Rapeseed, Parsley, Carrot, Carrot oil	✗
Salmon soup (Potato, onion, celery, leek, carrot, dill, black pepper)	Onion, Dill/Fennel, Celery, Parsnips	✗
Sweet & sour sauce (Tomato, onion, carrot, celery, green/red pepper, bamboo)	Onion, Pepper	✗
Cinnamon	Cinnamon	✓
Chives powder	Onion/chives	✓
Coriander powder	Coriander	✓
Garlic powder	Garlic	✓
Grilling spice (Bell & black pepper, coriander, garlic, chili)	Onion, Garlic, Chili/Pepper	✗
Pasta sauce (Onion, basil, garlic, parsley, oregano)	Onion/chives, Oat, Wild leek	✗
Pesto sauce (Basil, cashew, garlic)	Basil, Cashew	✗
Oregano	Oregano/Marjoram/Syrian oregano	✓
Tea	Tea plant	✓
Veggie dumplings (Wheat, potato, onion, dill, black pepper)	Rapeseed, Potato, Rye, Oat, Onion, Barley, Rapeseed, Dill/fennel	✗
Lentil and pea sprouts	Peas	✗
Smoked tofu	Soybean	✓
Wok veggies (Peas, beans, corn, soy bean, sunflower seeds, kidney beans, linseed)	Pea, Soybean, Common bean, sunflower, garlic, Corn, Parsley	✗
Frozen peas, corn, bell pepper	Pea, Pepper, Corn	✓
French fries	Potato	✓

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